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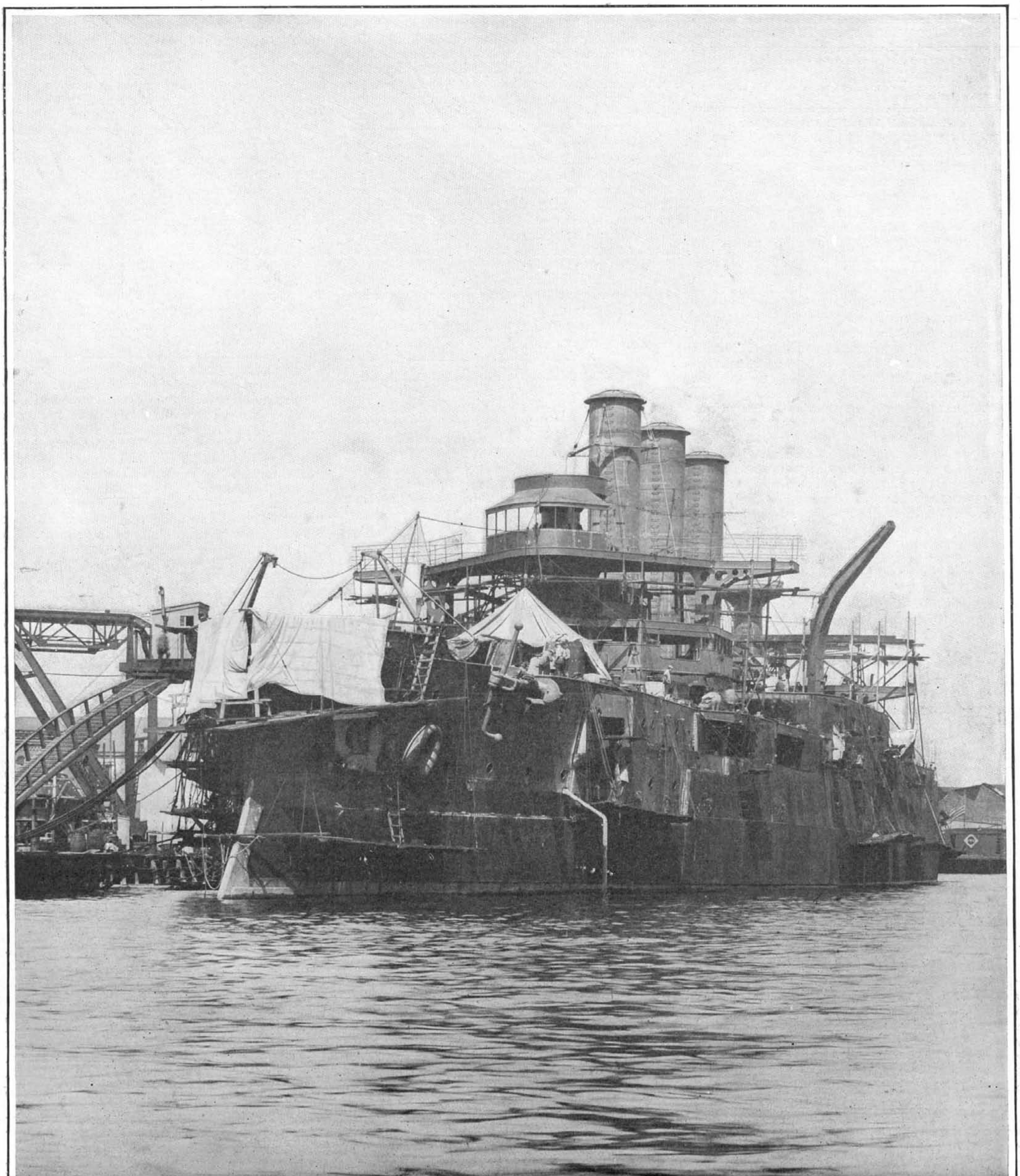

Keel laid, March 10, 1903. **Launched,** September 29, 1904. **Present condition,** 88 per cent completed. **Trials will take place,** March, 1906.

THE GOVERNMENT-BUILT BATTLESHIP "CONNECTICUT."—[See page 239.]

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NEW YORK, SATURDAY, SEPTEMBER 23, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE BICYCLE AND THE AUTOMOBILE.

The history of sports and pastimes in this country furnishes no parallel to the rapid growth in popularity of the bicycle, and its even more sudden decline as a means of recreation. Its decline is rendered the more puzzling when we remember that the medical profession indorsed bicycle riding as being, when followed in moderation, of valuable assistance in keeping the body in good condition, and in the cure and prevention of certain ailments that arise from sedentary habits and the lack of a proper amount of outdoor exercise. So true is this that if it were possible to gather the testimony of the hundreds of thousands of people in this country, whose "wheels" are to-day rusting in the cellar, or stored ingloriously among the top attic lumber, it would be found that not a few thousands of them would readily admit that they have never enjoyed the perfect health which was theirs when the Sunday trip into the country or the evening ride on the boulevards or cycle paths formed an important and pleasurable item in the routine of their lives.

The causes for the decline were many. The chief trouble was the very one that is threatening the automobile to-day—people rode too fast and too far; and those who were not gifted with the muscular and constitutional equipment necessary for riding centuries, or even half-centuries, without distress, began to associate the bicycle with aching limbs and an exhausted body. Another and scarcely less active cause of the decline was the introduction of cheap bicycles, and the placing of the wheel within reach of everybody who could find the necessary forty or fifty dollars for its purchase. Bicycling became unfashionable; and in this respect the decline of wheeling is one of the most startling signs of the fact that the American people are fast losing that independent, democratic spirit which for three centuries has been one of the distinguishing characteristics of the race. When the fad became unfashionable its death-knell as a pastime of universal popularity was sounded. The bicycle was relegated to uses purely utilitarian. As a means of transportation it will always fill a useful place in the economy of everyday life; but that bicycling will ever win back anything of its former position as one of the most fashionable and popular means of recreation is most improbable.

But what of the automobile? Will like causes produce like effects? Already the speed mania is threatening to work injury to automobile interests by multiplying the lists of casualties and provoking a prejudice in the public mind. It is gratifying to know that earnest efforts are being made by the great body of automobilists as a whole to prevent reckless driving, and save this splendid sport from the harm that was done to bicycling by the growth of the "scorching" habit. The introduction of cheap and reliable automobiles (and if the plans of certain firms do not miscarry, the market will within the next two or three years be flooded with such) will bring the automobile within reach of the pocketbook of ten times as many people as can afford a machine under existing conditions. Before many years the boulevards, concourses, and turnpike roads will swarm with devotees of the latest sport. Shall we in this splendid means of recreation see repeated the history of the bicycle? Will it become unfashionable? Possibly in a limited degree it will; although it must surely remain to the end of time one of the most useful means of transportation, both for freight and passengers, that invention has placed at the service of man, rivaling, if not surpassing, the locomotive and the trolley car.

There is this much to be said in favor of the prospects of the automobile maintaining its present popularity as a means of recreation, namely, that, unlike the bicycle, it affords a means of travel that is comparatively free from effort, and may be made, if so desired, positively luxurious.

LOSS OF THE FLAGSHIP "MIKASA."

It is the very irony of fate that the flagship "Mikasa," after enduring the stress of eighteen months of bitter warfare upon the high seas, should be lost ingloriously, during the piping times of peace, while riding at her moorings in a home port. Not merely the Japanese themselves, but the whole world must feel a sentimental interest in the ship that flew Admiral Togo's flag from the first naval engagement at Port Arthur to the final splendid triumph in the Sea of Japan. What the "Victory" was to Nelson, and the "Hartford" to Farragut, the "Mikasa" was to Togo; and when the latest chapter of naval history comes to be written, the two names will be indissolubly associated.

The "Mikasa" was a noble ship. She "looked the part" she was supposed to play, and she played it well. In the two great battles in which she was engaged, both the ship and its crew suffered more severely than any other Japanese ships in the line. At the time of her construction in 1901 she represented the latest theories and practice in battleship construction, and she will be surpassed only by the monster battleships, now proposed, whose distinctive features have been based upon the lessons derived from the performance of the "Mikasa" and her class when in action.

According to the dispatches, the loss of the ship was due to a fire, which started during the night and spread to the after magazine, which exploded and "blew a hole through the side of the ship," causing her to founder. It is difficult to understand how the explosion of the magazines could inflict merely a local injury. A catastrophe of that magnitude usually, as in the case of the "Maine," tears the ship absolutely in two. Hence the cabled statement that the ship sank in shallow water and can be raised is extremely puzzling. The mystery can be explained only by the publication of the official details of the disaster—something which the extreme reticence of the Japanese naval department renders very unlikely.

RISK OF DERAILMENT ON ELEVATED RAILROAD CURVES.

When the elevated railroad system in this city was opened, about a quarter of a century ago, it was freely predicted that sooner or later a derailment, accompanied by great loss of life, would occur. The public of that day considered that there was great risk in the operation of a railroad that was carried entirely upon an elevated structure, 20 or 30 feet above the street level. It is a really remarkable fact, and one that must be mentioned to the credit of the company, that in spite of the enormous traffic over the elevated system, a traffic which in density is not paralleled in any other place in the world, this is the first accident that has occurred involving a heavy loss of life. Such fatal accidents as have happened were due chiefly to collisions; derailments have been less frequent, and it was reserved for the shocking mishap of September 11 to record the first serious loss of life due to this cause.

The elevated railroads, considering the extremely sharp curves and the great number and comparatively high speed of the trains, have been, in fact, singularly free from derailments, and this is due to the excellent system of guard rails adopted, there being a guard rail on both sides of each rail, or four altogether to each track. Moreover, the guard rails are deep and well bolted, so that should a wheel leave the track it would be difficult for it to mount the guard rails and get away from the structure. At the same time engineers generally have realized that the elevated railroads in this city have presented and do now present a very serious source of danger at the sharp curves by which the tracks run from the avenues into cross streets. The tracks, as we have said, are heavily guarded at these points; where it is possible the outer rail is superelevated; and in every case a heavy steel rail takes the place of the ordinary guard rail on the inner track. These precautions are necessary, for the curves are so sharp that, if the trains are run around them at any speed above eight or ten miles an hour, the centrifugal force becomes excessive and there is a decided risk of the wheels climbing the track. Although the superelevation of the outer rail is a safeguard for moderate speeds, it affords but little protection when the speed rises above the particular maximum speed corresponding to any given superelevation, and there is no denying that elevated trains are being run around the curves at a speed much higher than the latter have been built for. An easy method of detecting whether the superelevation and the speed are properly related is to notice whether, on passing around a curve, the passengers are swung to the outside of the curve. If they are, the train is going too fast for that curve, and the more violent the outward fling, the more severely are the guard rails and the flanges of the wheels on the outer rail being strained. If the pressure upon them passes a certain point, it will become sufficient to enable them to "bite" and climb the track.

About the time of the introduction of electric traction on the Elevated, the engineers were running their trains around the curves at such a reckless speed that this journal entered a strong protest and pointed out the great risks incurred. The speed was immediately modified, and for some time after the line was electrified, we noticed that great care was being taken in passing the curves. Gradually, however, as the motormen, and possibly the superintendents and other officials, have become familiarized with the higher speeds which are possible under electric traction, they have permitted, unconsciously perhaps, the use of an excessive rate of speed around these curves, until, as matters now stand, the trains, and especially the last few cars, are being whipped around the curves at a speed that simply invites disaster.

As we have shown elsewhere in this issue, the accident at Ninth Avenue and Fifty-third Street was due to the fact that a train which was running down Ninth Avenue found itself suddenly switched into the curve leading to Fifty-third Street. It is probable that the whole train would have remained on the tracks and gone straight around the curve, had the outer rail been properly superelevated; but superelevation is impossible at this point, for the reason that the outer rails of the Fifty-third Street curves have to be kept down at level grade in order to carry them across the Ninth Avenue rails.

The crossing at which this accident occurred is a notoriously dangerous one. Much of the risk is due to the present system of operation in which too much is left to the "human element." The danger could be eliminated by introducing the automatic stop and placing it in such a position that when the switch was set for Fifty-third Street, it would stop Ninth Avenue trains, but would allow Sixth Avenue trains to run through. This is an age of automatic control, and in the presence of the late awful disaster, it is binding upon the Interborough Company to place the control of this dangerous crossing as far as possible under automatic supervision.

AN IMPORTANT INNOVATION IN TELEGRAPHY.

The important problem of economy in the works of telegraphic services has just been solved by a new technical application of the very greatest importance. The gravity of the problem in question will at once be recognized when it is borne in mind that, at the present day, there is a steadily increasing rise in the cost of public services in all civilized countries, due to a growing demand for new and indispensable lines and for increased speed in transmission, thus necessitating use of costly apparatus requiring an augmentation in the electromotive energy employed in electric stations.

Signor Magini, an Italian electrical engineer, well known already for several useful innovations in the field of electro-technics, has recently been devoting much study to the operation of the coherer inserted above a telegraphic wire subjected to electric vibrations originating from a low-power induction coil. His observations have led him to the discovery of an extremely simple arrangement which solves in a very happy manner various problems still existing in connection with every-day telegraphy. In addition to this the device works equally well whatever the distance may be between the telegraphic stations, and whatsoever the material condition of the wires in use on existing lines. There would thus be no need to make alterations in existing services but, it may be pointed out, that with the new system telegraphic communication may also be carried out under existing generic conditions by means of very thin wires, instead of the thick and expensive conductors or "leads" now generally employed—a point of exceptional importance, especially in connection with the erection of new installations. All competent persons will at once recognize the importance of the innovation from the above brief remarks as to the actual condition of telegraphic wires. As a matter of fact, interruptions in telegraphic services depend almost always upon defective insulation of the conductors (especially during bad weather), upon short circuits, "earths," etc.; fortunately all these causes have no effect at all upon the transmission of the new currents selected and practically employed by Signor Magini. These currents are of an oscillating character and neither disturb, nor are disturbed by, ordinary currents—a fact the importance of which cannot escape the attention of those who understand anything about telegraphy; furthermore, they have the singular property of rapidly passing over electric conductors even when such "leads" are imperfectly insulated (whether due to bad weather or other causes) or have not been insulated at all, and also if short-circuited to earth or if the continuity be even interrupted. To put the matter briefly, the new "Magini system" insures perfect telegraphic communication under even the worst possible conditions in the electric status of the leads.

Magini's transmitter comprises a small Ruhmkorff coil, into the primary circuit of which there are sent, by means of a special key, currents emanating from the few cells of some dry batteries, while one of the terminals of the secondary circuit is placed in communi-

cation with the lead. The current, inducted by a special arrangement of the circuit which is as simple as it is original (both at the transmitter and receiver ends) is transformed into a vibratory pulsating current; at the receiving station it reaches a coherer of special construction and causes the operation of any suitable telegraphic apparatus, using either Morse signals or printing signs, etc., on the Hughes principle. This coherer (which is apparently directly opposed to all coherers hitherto known) establishes or breaks its coherency with rapidity and certainty; once placed in operation it continues to work with perfect precision, all the drawbacks (such as excessive sensitiveness, always causing great variability) common to other types so far known having been successfully done away with. This new coherer will, therefore, be of great value for use in connection with wireless telegraphy.

Although only a few volts are used at the transmitting station, and while there are only two dry cells at the receiving center, still messages can be safely forwarded over distances amounting to hundreds of miles; hence with the new Magini system the use of cumbersome and expensive batteries of cells or accumulators at telegraphic stations becomes a thing of the past.

The new system practically admits of duplex telegraphy, without recourse to the actual complicated means employed—means which necessitate scientific and special technical knowledge on the part of the employes and which, furthermore, are exposed to all those multiple causes which induce modifications in the electric condition of the wires, thus necessitating continual variation and readjustment of the electric accord existing between the different offices or stations. When mounted in derivation on the two extremes of an electric wire, Magini's transmitter and receiver do not necessitate any alteration in existing plant, and two different messages can also be sent over the same wire at one and the same time.

A further, and very valuable, application of this system lies in its applicability to use in submarine work; not only does it double the power of the cable, but it also enables two messages to be sent together over one and the same cable.

The high charges made for sending telegrams over long submarine cables is due to their low capacity, when considered in proportion to time and to the large amount of capital invested therein. The possibility of doubling their present capacity, and of transmitting two messages at once, hence will be equivalent to reducing the present charges for cables by one-half.

As the currents employed by Magini have the peculiar property of being able to jump over gaps or breaks in the leads and continue their journey undisturbed, this gentleman has been able to maintain uninterrupted communication over wires and cables, the inner core or conductor of which has been broken—i. e., under conditions with which existing methods would have been entirely unable to cope. Consequently, should a submarine cable become worn out, or unserviceable for any other reason (e. g., accidental breakage of the core during laying, infiltration of sea water and consequent rusting due to electrolysis, *et hoc genus omne*), telegraphic communication can nevertheless be kept up with Magini's system until the long and costly operations of fishing up and repairing the cable are completed.

THE EFFECT OF HYDROGEN ON GAS ENGINE COMPRESSION.

BY GEORGE M. S. TAIT.

As many are aware, one of the main difficulties encountered in the steady performance of a producer-gas-operated gas engine is caused by the fluctuation in the quality of the gas generated by the producer, and as a proof of this we have all noticed the excellent performances obtained from gas engines operating on illuminating or natural gas, of a fixed analysis, as compared with the somewhat varying runs obtained with the same engines when operating on producer gas. This absence observed in the operation of the engine is more noticeable in conjunction with the suction type of producer where no gas holder is employed, the reason for this being that momentary variations which always occur in the present type of producer are not felt so much where a large gas holder is employed, as the lean gas has an opportunity for mixing with the other gas already in the holder, with the result that the supply drawn by the engine is more or less of a constant quality.

In acknowledging, therefore, that the quality of producer gas varies, our next step is to ascertain the cause of this variation and to indicate if possible a remedy therefor.

The theoretical analysis of producer gas made from anthracite coal would be about as follows:

CO	27.0 per cent by volume.
H	12.0 per cent by volume.
CH_4	1.2 per cent by volume.
CO_2	2.5 per cent by volume.
N	57.0 per cent by volume.
O	0.3 per cent by volume.

B. T. U., 137.5 per cubic foot.

Unfortunately, however, in practice the quantity of CO will be found to be much lower than the above, while CO_2 and H will correspondingly increase. This change in the gas is, however, not shown by the usual calorimeter test, due partly to the fact that as the CO decreases it is offset as far as heating value goes by the increase of H; this increase sometimes causes a rise in B. T. U. above the figures first mentioned.

However, a gas high in B. T. U. is not necessarily a good gas for engines, especially if by this increase we have to sacrifice high compression in order to guard against pre-ignition; and as, in the case of the present producers, high B. T. U. generally means a high percentage of H, this increase in heating value proves to be rather a detriment than otherwise to the engine performance.

The engine builder is aware that his compression must be governed by the maximum amount of hydrogen which his engine is liable to encounter at any time during the run, and he therefore is forced to put the compression much lower than he otherwise would do in order to safeguard himself against pre-ignitions. It would appear, therefore, that if a gas sufficiently rich, but at the same time having little or no H, could be manufactured, ideal results would be obtained.

That this is the case has been demonstrated by the wonderful results obtained in Europe from gas engines operating on blast furnace gas, which, although of a very low heating value, are free from H and consequently admit of a very high compression on the engines. In support of this argument it is interesting to note that gas engines are now operating on 9,500 B. T. U. and even less per brake horse-power on this gas, where the compression has been raised to 200 pounds, whereas the same make of engines operating on producer gas of a richer quality, but containing H, are found to consume from 11,000 to 12,500 B. T. U. per brake horse-power, but with a compression of only 130 pounds. The present outfit for the manufacture of producer gas comprises a producer, scrubber, purifier, and in some cases a gas storage tank or holder. The fuel is burned incompletely in the producer either by forced or induced draft, the resulting gas passing off to the engines.

Now in practice it is found that the fuel bed would get intensely hot if supplied with air alone, and as this condition would cause undue clinkering of the fuel as well as a lean gas, there is introduced steam or water vapor along with the incoming air for the double object of lowering the temperature of the fire by the heat-absorbing property of the steam, and in cases where the temperature is high enough the dissociation of said steam or water vapor occurs, the oxygen uniting with the carbon of the coal to form CO while the H passes off in the gas, enriching the same materially.

The one defective feature of this system is that the percentage of H is continually changing, owing to the varying temperatures of the fire, which at one time is too cool to decompose the steam and merely allows the same to pass through the fuel bed in a superheated condition; while at other times when the demand for gas is greater and the rate of combustion consequently higher the resultant rise in temperature dissociates the steam, making a variation in all of from 5 to 20 per cent of H in the gas by volume.

The engine builder, being aware of this unknown quantity in the form of H upon which his engine has to operate, is compelled to sacrifice high compression and the incident economies therefrom in order to guard against pre-ignitions and to lower the compression so that the working efficiency of the plant is very much impaired.

That the compression at which the engine operates has a powerful effect on the economy of the plant is well set off by the performances of a certain well-known make of engine on producer gas containing hydrogen, and blast furnace gas containing no hydrogen, as follows: In the first instance the engine, the compression of which was set to 120 pounds, uses 11,500 B. T. U. per brake horse-power per hour, while in the second instance engines of the same make with a compression of from 170 to 200 pounds are operating steadily on 9,500 B. T. U. per brake horse-power.

This enormous saving accomplished solely by increasing the compression, is very obvious, and when it is realized that these results are only possible where H is eliminated from the gas it would seem that a producer which would supply a gas sufficiently high in CO to obviate the necessity of too large a cylinder would give ideal results in engine practice.

Having this object in view, producer manufacturers have long been experimenting with other diluents to take the place of steam, but until very recently nothing satisfactory had been accomplished. Now, however, there are two or three plants in the course of erection upon which a new system is being tried in which the steam is replaced by a diluent consisting of cooled exhaust gases, which bids fair to answer all requirements.

The action of this substitute for steam is said to be very marked, the CO_2 in the exhaust gases burning back to CO when passing up through the fuel in the producer, absorbing heat, while at the same time the analysis of the gas shows a higher percentage of CO, which along with the high compression admissible is expected to offset the absence of H.

The special feature of the gas in this system that should recommend itself to engine builders is the fact that the analysis remains fairly constant under varying loads, and owing to the absence of hydrogen and consequent dangers from pre-ignition very high compressions should be safely carried without danger accruing therefrom.

It is expected when the installations embodying the improvements are perfected a solution may be found for the difficulties heretofore experienced.

THE PHONOCARD.

The phonopostal, says La Nature, is an apparatus which registers and afterward reproduces the human voice, by means of a sheet of pasteboard, shaped like a postal card. Jules Verne conceived the idea of replacing the old wax cylinder used in other phonographs by a sheet of paper, which could be posted like a letter.

The advantages of the phonopostal are numerous. The records are made by an ordinary phonograph of the simplest possible type simply by means of a stylus provided with a sapphire point. This point presses on an impressionable substance, called "*sonorine*," spread on the surface of the card. The merit of the invention consists in the discovery of a substance which can be easily spread on a sheet of cardboard and possesses all the advantages of the wax-coated cylinders. Moreover, sonorine is able to stand the strain of transmission by mail. The sounds are inscribed in a spiral, which commences at the outside edge of the card and continues in an ever-narrowing curve until it forms a small circle, hardly the diameter of a small coin. The record is so deeply engraved in the coated cardboard that not more than two or three syllables are lost by the two stampings of the post office on the concentric lines.

Seventy-five or eighty words can be inscribed on a phonocard, which is sufficient for news. One object of the phonocard is to replace the illustrated postal card. Furthermore, it is possible to be far more chatty on a phonopostal than on an ordinary postal card, for on the latter there is only a little rectangular space left which can be written on.

THE CURRENT SUPPLEMENT.

The United States Geological Survey has for a number of years been studying the underground waters beneath the central great plains. The investigation is reviewed in a strikingly illustrated article which opens the current SUPPLEMENT, No. 1551. Mr. M. T. Cook writes on the banana. A highly instructive article is that on the spider and its web, by Maurice Koechlin. Prof. Sommer explains simply and clearly some methods which he has devised of investigating movements of expression. Sir William Crookes delivered an impressive paper on diamonds before the South African meeting of the British Association for the Advancement of Science. The first installment of the paper is published in the current SUPPLEMENT. A number of extensive automobile testing laboratories have recently been fitted up in Paris. One of these is very fully described and illustrated. Mr. Walter L. Webb contributes an instructive paper on reinforced concrete, explaining its principles, with practical illustrations. "Electric Lighting for Amateurs" is the title of a lucidly-worded and fully-illustrated article describing some simple electrical work that can be carried out at home. Mr. H. Lemmoin-Cannon discusses the problem of sewage and its disposal. J. H. Long discusses the important question of protein and its relation to food.

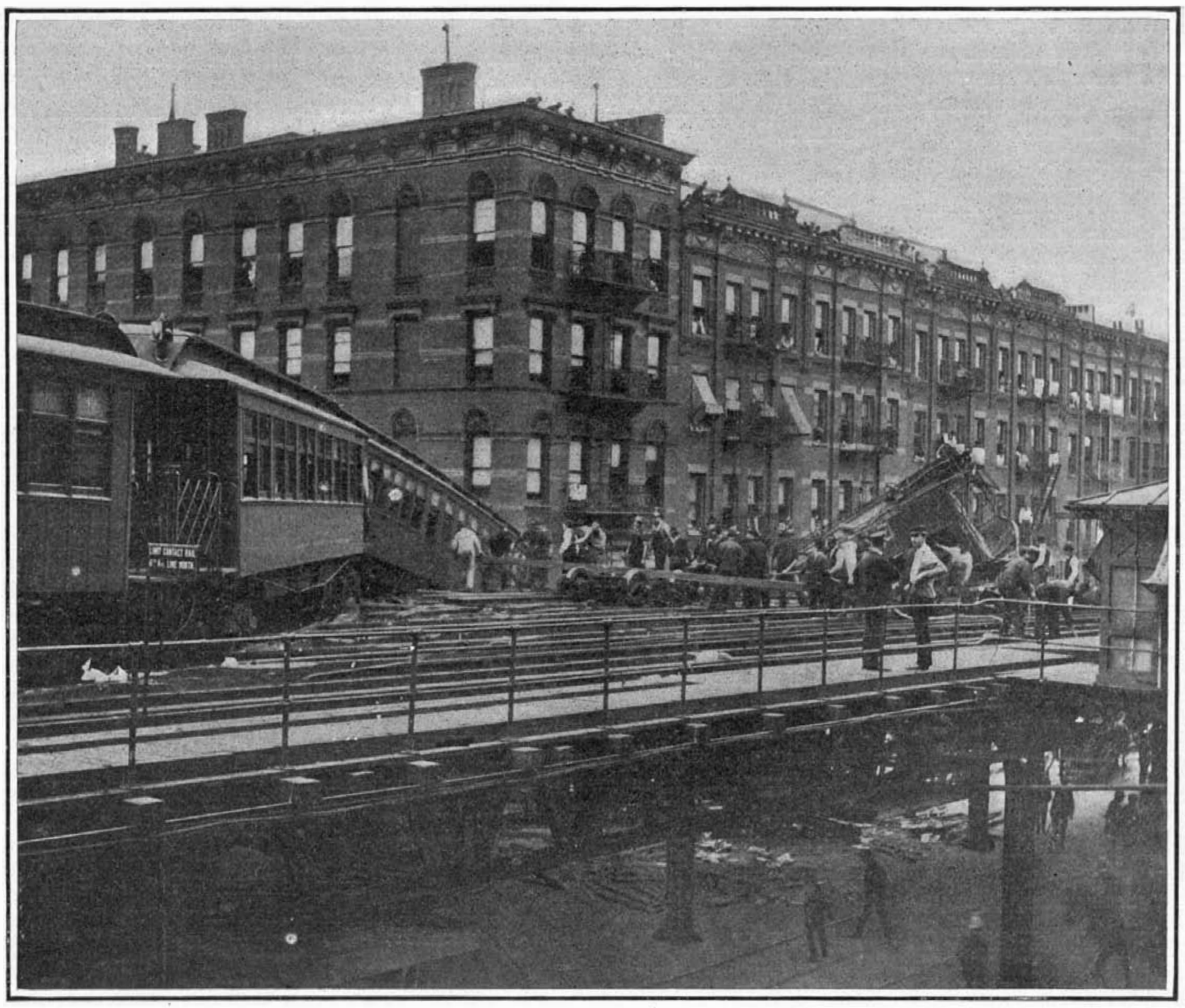
PRODUCING HIGH VACUA.

The German scientific journal Prometheus states that the English physicist Dewar has found a new process for obtaining high vacua, which forms another practical employment of liquid air. It is known already that charcoal possesses the property in a high degree of absorbing gases. Dewar has demonstrated that this absorptive property of charcoal increases manifold if it is cooled to the temperature of liquid air (about 185). The absorption takes place so energetically that if the charcoal is contained in a closed vessel the latter soon becomes void of air.

Where formerly the quicksilver pump had to be worked incessantly for hours and days, it now suffices to attach a tube to the vessel intended to be freed of air, into which some charcoal, preferably of cocoanut shell, is placed, which has been immersed in liquid air. In this manner a vacuum is obtained within a few minutes suitable for producing cathode or X-rays. This method possesses also the advantage that the moisture, which can sometimes be only removed with difficulty from the vessel, is at once condensed in the tube.

THE ELEVATED RAILROAD WRECK IN NEW YORK.

The recent fatal accident on the elevated railroad in this city was due to the fact that a train that was running at a speed of twenty to thirty miles an hour attempted to pass around a curve on which the safe speed was only eight or ten miles an hour. In spite of the heavy guard rails on the inside and outside of the rails the tremendous centrifugal thrust caused two of the cars to climb the track and plunge over the edge of the elevated structure. At the point where the accident happened, at 53d Street and Ninth Avenue, there is a junction of the Sixth Avenue branch of the elevated with the Ninth Avenue branch. The cars curve off from the avenue into the cross street with the characteristic abruptness of all such elevated railway curves. As this curve has to be carried across the Ninth Avenue tracks, it is impossible to superelevate the outside rails, since to do so would bring them several inches above the level of the Ninth Avenue tracks and produce a dangerous hump in the same. A curve with similar conditions exists at 53d Street and Sixth Avenue. Evidently, from what has been said, the trains that take either of these curves should be run at a much slower speed than they can on curves that are properly superelevated. The trains that are intended for Sixth Avenue are switched into 53d Street by a man who is stationed in a signal cabin at the point where the Sixth Avenue branch begins. It is his duty to watch the colored disks which are carried at the front end of each train to indicate whether it is to run down Ninth Avenue or Sixth Avenue, and set the switches accordingly. On this particular occasion a Ninth Avenue train, apparently with its disks properly set, came rapidly down the grade from 59th Street station, but through some error was switched onto the sharp curve into 53d Street. The first car, which was a heavy motor car, swayed over heavily as it struck the curve, but passed safely around and was brought to a stop not far from the wrecked train. The second car, however, was what is known as a "trailer," that is, a light car without motors, and it jumped the track almost as soon as it passed onto the curve, wrenched loose from the heavy motor car ahead, breaking the couplings, drove ahead diagonally across the Ninth Avenue tracks, swung completely around, and fell over onto the sidewalk below. As it fell, the car rolled completely over so that it struck roof down, one end of the car resting on its roof on the elevated structure, and the lower end resting upon the crumpled-up wreck of the roof and the front of the car, on the street below. The car, and in fact the whole train, was densely crowded with working people, who, as the car struck the street, were flung to the forward end, where most of the fatalities occurred, a dozen lives being lost and some two score being more or less seriously wounded.



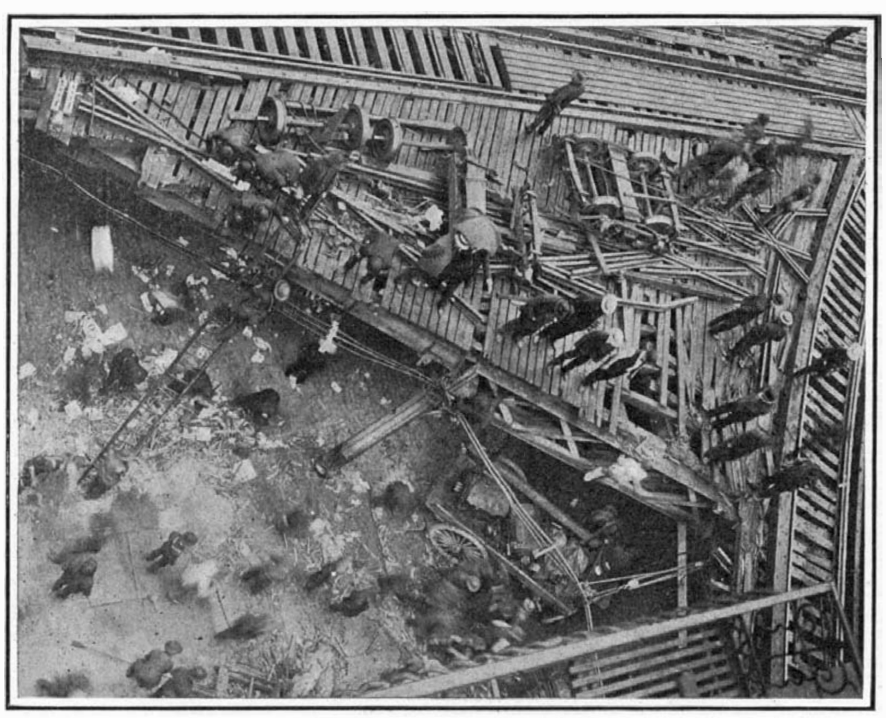
View Looking Southeast, Showing to the Upper End of the Second Car, and the Position of the Third and Following Cars of the Train.

The third car was carried forward by the momentum of the train directly against the northwest corner of the adjacent building, where it came to rest with its front platform about on a level with the fire escape of the second floor of the building, and its rear half resting on the elevated structure, in the position shown in one of our engravings. The people in this car escaped by climbing from the platform to the fire escape, from which they made their way to the street. The other cars to the rear remained on the track and suffered no injury, not even the glass in the windows being broken. This is accounted for by the fact that the instant the coupling between the first car which rounded the curve and the second car was broken, the brakes were automatically set throughout the whole train, and this, coupled with the resistance of the two wrecked cars as they crashed across the guard rails and tracks, served to bring the rear half of the train to a stop so gradually that no injuries resulted either to the passengers or the cars themselves.

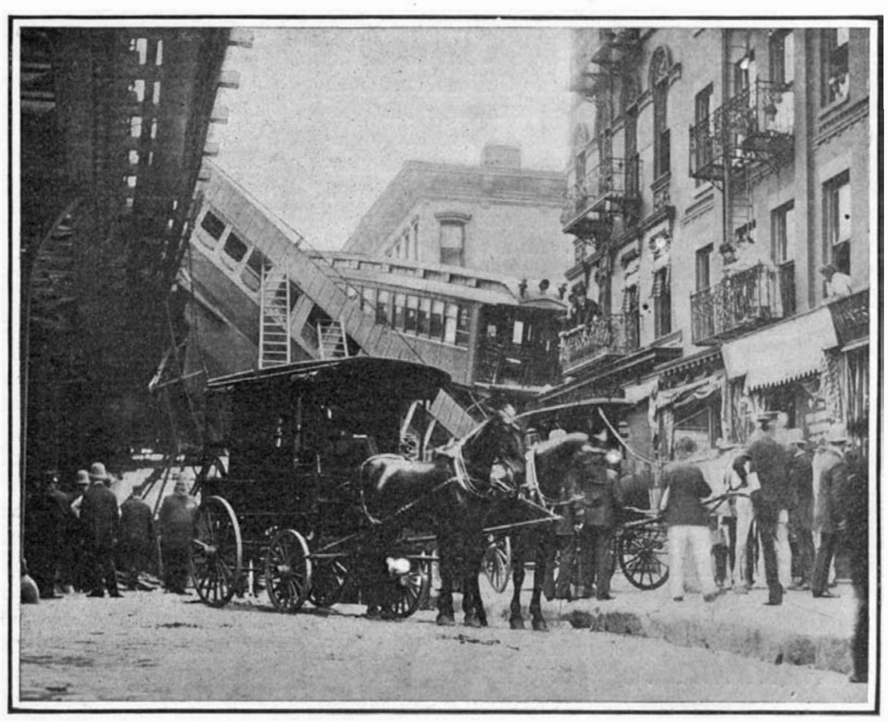
When the second car turned over and fell to the street the upper structure, such as the roofs and sides, was completely wrecked, the roof being practically opened out its entire length. The car was one of the lighter pattern built when the elevated was a steam railroad; and although it was amply strong to resist the stresses of ordinary operation, it proved to be an utter death trap when exposed to the rough handling of this derailment. Herein we find another argument for the rapid introduction of all-steel cars. Had this second car been of the same type as the heavy steel motor cars of the Subway, it would probably have kept the track, or, if it had been derailed and thrown to the street, it would have maintained its form sufficiently to have prevented much of the terrible loss of life. It has been proved over and over again that all-steel freight cars will pass through a derailment or a collision and retain their shape so that they are easily repaired and put in service again, while the wooden cars in the same collision will be broken up beyond recovery. In the presence of this disaster, we cannot but feel that another urgent call is being made for the rapid substitution of steel for wooden cars in passenger service.

Electrification of Swiss Standard-Gage Railways.

It is said that the Oerlikon Machine Works, of Oerlikon, Switzerland, and the Siemens-Schuckert Works, of Berlin, have arrived at an agreement according to which these two firms will take up jointly the study of the problem of the electrification of the Swiss standard-gage railways, as well as execute any business transactions in connection therewith.



View Showing the Ninth Avenue Uptown Track, the Curve of the Downtown Track Leading to 53d Street, and the Sidewalk upon Which the Second Car of the Train Landed.



The Overturned Car is Shown with One End on the Viaduct and the Other on the Street. The Second Car of the Train is Resting Half on the Viaduct with Its Front End Against the Building.

THE ELEVATED RAILROAD WRECK.

OUR NAVAL GUNS IN THE CIVIL WAR AND TO-DAY.

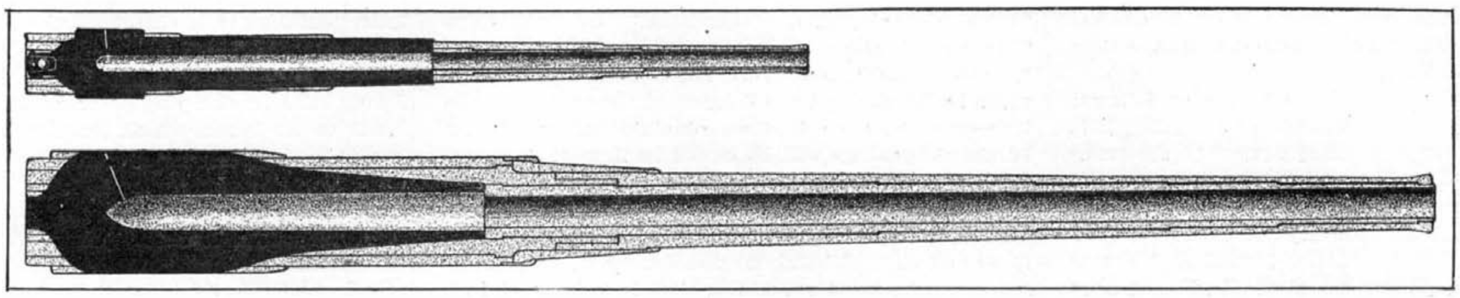
Naval ordnance has made greater strides in the forty years that have intervened since the civil war than in several centuries preceding. As proof of this it is enough to look at the striking comparison shown in the accompanying cut. The smaller illustration represents a Parrott 100-pounder of 1862, superimposed upon a modern 100-pounder, or to be correct, a 6-inch 50-caliber, rapid-fire rifle, of the year 1902; the lower diagram represents a 15-inch smooth bore of the civil war superimposed upon a 12-inch breech-loading 45-caliber rifle of to-day. The comparison might be carried out at greater length throughout all the various calibers that constitute the batteries of naval ships, but it is sufficient to compare the main battery of the "Monitor" with the main battery of the modern battleship, and what might be called the secondary battery of the frigates of 1862 with the standard secondary battery gun of the battleship of to-day.

The heaviest piece carried in the civil war was the 15-inch smooth bore. This gun weighed 42,000 pounds; its length over all was 15 feet 1 inch; its maximum diameter at the breech was 4 feet, and with an ordinary charge of 35 pounds of black cannon powder, it fired a spherical shell weighing 350 pounds. According to the ordnance regulations, under extraordinary conditions, these guns might be fired 20 rounds "at ironclads at close quarters," using 100 pounds of hexagonal or cubical powder and a solid shot weighing 450 pounds. Under these conditions the respectable muzzle velocity of 1,600 foot-seconds was obtained, with a corresponding muzzle energy of 7,997 foot-tons. It would be interesting to know what the powder pressure was under these conditions, for the velocity and energy are something truly remarkable for a cast-iron gun. It is little wonder that only 20 rounds were allowed under the severe stresses imposed by these ballistics.

Now, compare these results with the most powerful gun in our navy to-day, namely, the 12-inch, 45-caliber rifle, which weighs 53.4 tons, has a total length of 45 feet, and with a charge of 360 pounds of smokeless powder fires an 850-pound shell with a muzzle velocity of 2,800 foot-seconds, and a muzzle energy of 46,246 foot tons. The true basis of comparison of the relative efficiencies of the two guns is the amount of energy developed per ton of the weight of the gun, and on this basis we find that the old 15-inch, smooth-bore gun when fired with 100 pounds of powder, developed 427 foot-tons of energy per ton of gun, as against 872 foot-tons of energy per ton developed by the modern 12-inch gun.

If we take account of the durability of a gun the advantage will be strongly on the side of the modern piece, for whereas the 15-inch smooth-bore was limited to twenty rounds under the given conditions, the modern 12-inch rifles, judging from the small amount of erosion developed with nitro-cellulose powders, should have a useful life of at least half a thousand rounds. Moreover, it must be remembered that the modern elongated shell will hold its velocity much longer than the old spherical shell of the smooth-bore, and, consequently, the respective muzzle velocities and energies are not an exact criterion of efficiency.

The gun of 1862 that answers to the modern secondary battery, 6-inch rifle, is the Parrott muzzle-loading rifle, a cast-iron gun which was strengthened at the breech over the powder chamber by shrinking thereon an iron hoop. The bore of the gun was 6.4 inches. It weighed 4.35 tons, was 12 feet 4 inches in length and with a charge of 10 pounds of powder it fired a 100-pound shell with an initial velocity of 1,080 foot-seconds and a muzzle energy of 810 foot-tons. Compare this with the modern 6-inch rifle, which weighs 8.5 tons, is 25 feet in length, and with a charge of 40 pounds of smokeless powder fires a 100-pound shell with an initial velocity of 2,900 feet per second and an initial energy of 5,838 foot-tons. Compared on the basis of energy per ton of gun, we find that the 100-pounder Parrott muzzle loader developed 186 foot-tons of energy per ton of gun, whereas the modern 6-inch breech-loading rifle develops 784½ foot-tons of energy per ton of gun.



The Parrott 100-Pound Rifle and the 15-Inch Smooth-bore (Period of Civil War) Compared with the 50-Caliber 6-Inch and the 45-Caliber 12-Inch Rifles of 1902. Civil War Guns in Black.

OUR NAVAL GUNS IN THE CIVIL WAR AND TO-DAY.

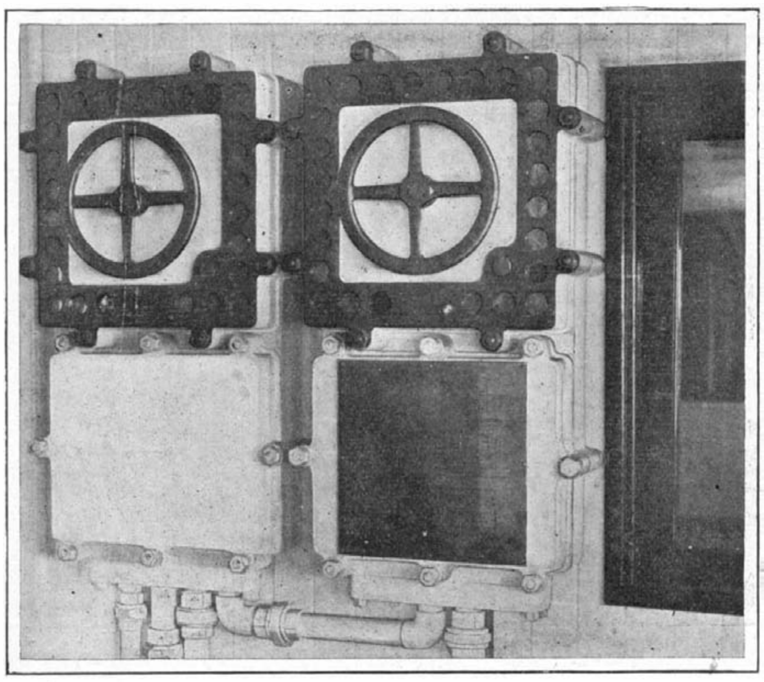
ELECTRICAL CONTROL OF BULKHEAD DOORS ON WARSHIPS.

Electricity has now finally supplanted hydraulic and pneumatic pressure in the control of bulkhead doors and armored hatches on the ships of the American navy. The armored cruiser "Colorado" just completed, is the first vessel in any navy to be equipped with a full complement of water-tight doors, electrically controlled. The new system is entirely an American development, although it is understood that the admiralty offices of several foreign nations are interesting themselves in it.

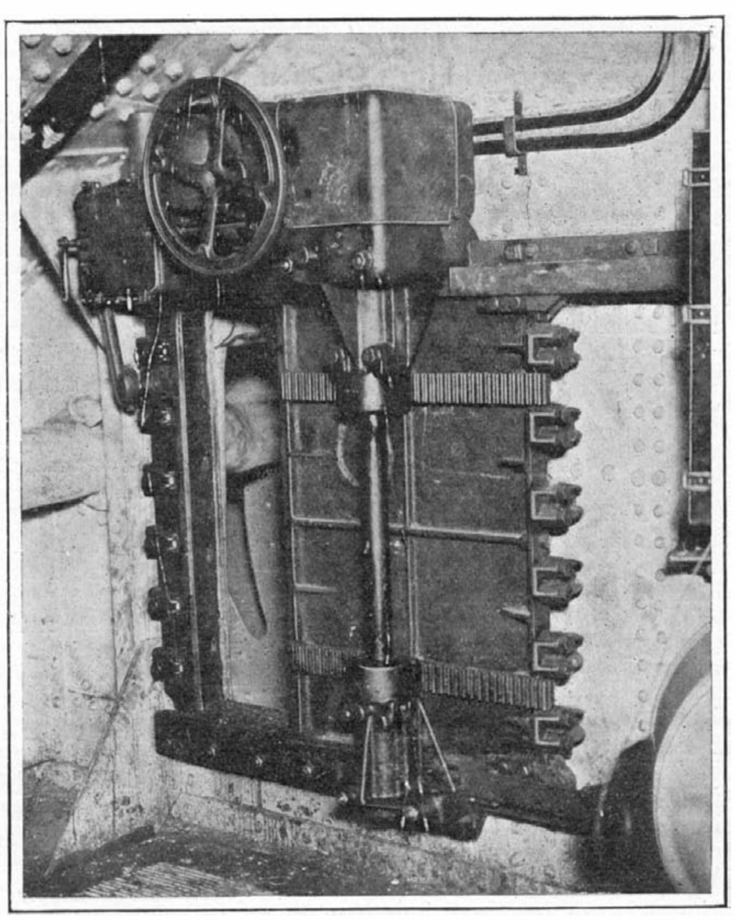
The installation on the "Colorado" was in accordance with Navy Department specifications stipulating that "each such door or hatch must be capable of permitting operation on the spot by power or by hand from either side of the bulkhead or deck, and all such doors are to be capable of being closed by power, simultaneously, from the emergency station. During any period of simultaneous or emergency closing full control must be maintained for opening any individual door on the spot, either by power or by hand, from either side of the bulkhead, and after any individual opening the emergency closing must repeat itself automatically. Approved means must be adopted to indicate continuously at the emergency station, during every emergency period when each door is shut and locked."

These requirements were based on a long series of experiments with hydraulically-controlled doors on the cruiser "Chicago" and pneumatically-controlled doors on the battleships "Maine" and "Missouri," as well as several other cruisers. It was found that the older methods of control were vitally deficient in their failure adequately to provide for local control or to prevent doors from closing suddenly and without warning. This defect tended to create hostility toward the apparatus on the part of the man whose duties might require him to pass through the door or who might become imprisoned in a compartment in case of accident. The pneumatic and hydraulic doors also leaked and were an unending source of annoyance aboard the ship. Having ever in mind, however, the lessons taught by the sinking of the British man-of-war "Victoria" (whose doors were open at the critical moment), the Navy Department has encouraged the development of a door which would effectually safeguard the man and equally effectually insure the safety of the ship.

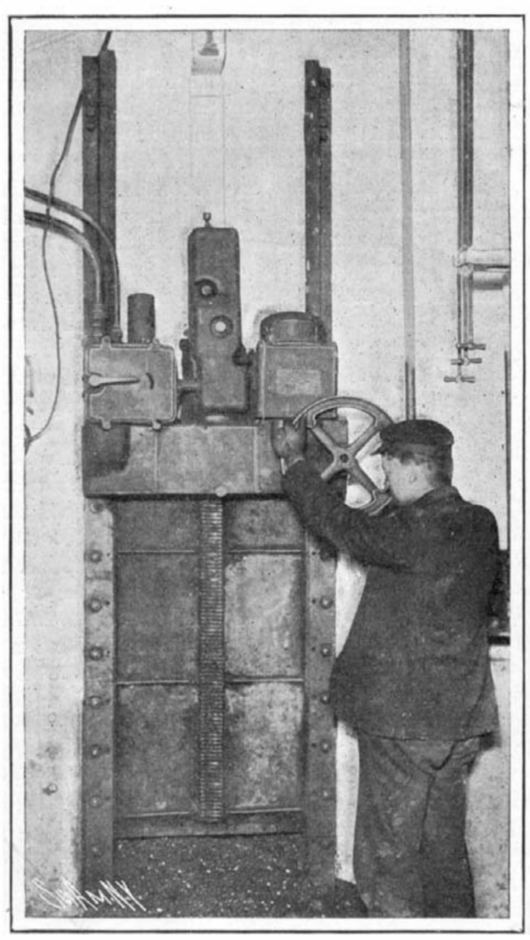
The present system consists of a central emergency station connected with the controller on each door and hatch gear by one twin conductor. The working parts of the emergency station are located in a water-tight brass case which is installed on the wall of the pilot house, the bridge, or in some other place convenient to the officer of the deck. The essential parts of the station are: (1) the mechanism for controlling the circuits running to each door or hatch



Emergency Station in the Pilot House.



A Horizontally Closing Door, Showing the Motor, Rack, Hand Controller and Hand Gear.



Closing a Vertically-Operating Bunker Door by Hand Gear.

ELECTRICAL CONTROL OF BULKHEAD DOORS ON WARSHIPS.

gear for closing the same; (2) the lamps to indicate the closure of each door or hatch; and (3) a fuse box in which each wire is provided with the proper fuse. On each door or hatch-plate there is a direct-current motor, reversible, compound-wound, bipolar, constructed for intermittent service and entirely inclosed in a water-tight case. This motor is capable of one horse-power under normal conditions, but will carry without injury an overload of 50 per cent for five minutes and 400 per cent for 10 seconds. Each door is also provided with a hand controller for opening the door when the current from the emergency station is on and with a hand gear for opening and closing the door without the aid of the motor.

The operation of the system is briefly as follows: If the ship is in danger of collision or ramming, it is the duty of the officer or seaman nearest to the emergency station to pull a latch similar to that of a fire alarm box, which releases the gearing within the station. This gearing automatically closes the circuits operating the emergency switches located in the controller in each door. It does not start all of the motors at the same time, thus avoiding the necessity for the enormous supply of current which would arise if all were started at once; but so nicely is the operation of the emergency station adapted that twenty-five doors and hatch gears can be closed in 1 minute and 15 seconds without more than four motors being in operation at any one time. As each door shuts it closes automatically a circuit running to the emergency station and connected with an incandescent electric light therein located. These lamps show in the photograph of the station in the form of a border of transparent disks each numbered to correspond with one of twenty-five doors or hatches. If there is an obstruction at any door such as to prevent its closure, the fact will be indicated by the failure of the lamp back of the corresponding disk to light. During the time the emergency current is turned on a red indicator lamp burns continuously so that a mere glance at the station shows whether the emergency is on or off.

The door controllers contain three independent switch mechanisms, the most important of which is the one used to open the door while the emergency current is on. This is to avoid the possibility of members of the crew being imprisoned and suffocated in compartments closed from the emergency station. By simply raising the hand lever the door is made to move backward, allow time for passage and then close again. The second switch is operated from the emergency station, and is the one by which the doors are closed. Its operation can only be suspended temporarily in the manner just described, and the door will always close as soon as the controller lever is released. The third switch is made necessary by the fact that blowouts of fuses would otherwise occur if the door in closing should encounter an obstacle such as a bag of coal or piece of timber left in the opening. This switch is operated by mechanical connection with the door or hatchway, and after an obstruction is removed the switch will again close the circuit to the motor and the door will go on its way toward its grooves without further attention. This switch is an essential part of the system, for without it an obstruction would result in a blowout of the fuses protecting the motor and prevent subsequent operation until these fuses had been replaced.

Another important part of the new device is the tightening gear. This was a feature of the power door which involved some difficulty for the reason that the door must be allowed room for free action between the guides and must at the same time fit so well as to prevent escape of water under pressure equivalent to a head of 35 feet. The tightening gear in the door is a great improvement over the old method of using two wedge surfaces. It substitutes an arrangement consisting of a wedge acting against a curved surface, thus securing more water-tight closure while avoiding the possibility of jamming. It also makes it impossible for coal and other material to find lodgment between the wedges—something that was very likely to occur in the power doors between coal bunkers and the fire rooms.

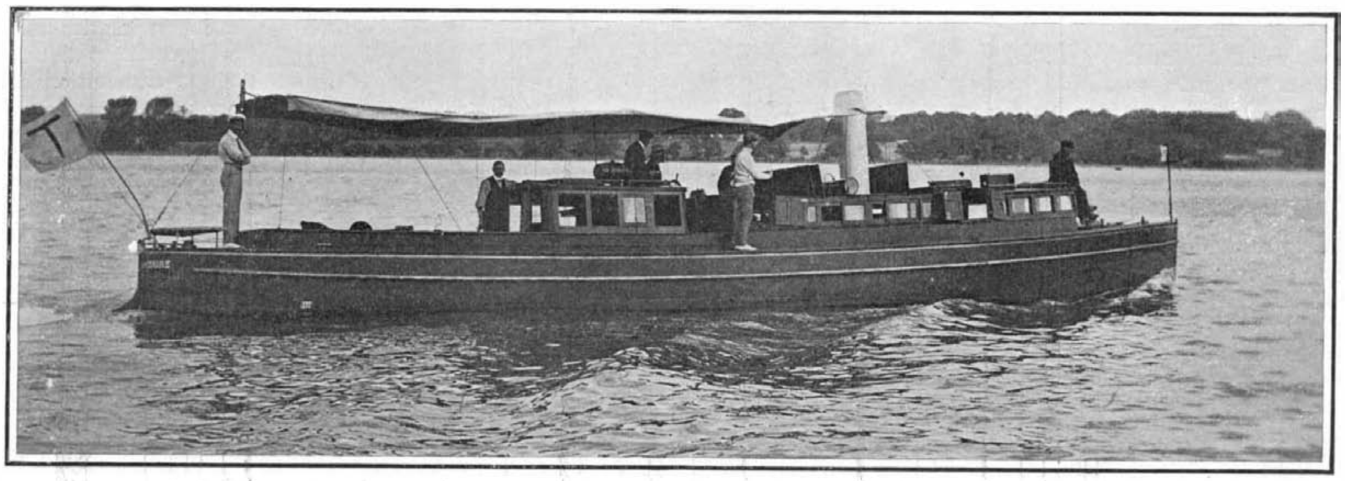
Reference to the illustrations will clear up any doubt the reader may have as to the details of the operation of the system so far as the doors are concerned. In the picture of a vertical coal-bunker door the controller is shown on the left, the motor on the right. At the time the picture was taken the door was being closed by the auxiliary hand wheel. In the photograph of the horizontal door the controller box is also on the left and the motor in the center. In this picture will also be noticed the double rack in which operate cog wheels attached to the vertical shaft turned from above by the motor. In the case of hatch-plates a lifting mechanism is substituted for the rack and cog wheels.

The "long arm" system, just described, is now installed on the armored cruisers "Colorado," "Pennsylvania," "Tennessee," "California," "South Dakota," "West Virginia," and "Maryland," the battleships "Louisiana," "Minnesota," "Connecticut," "New Jersey," "Rhode Island," and "Vermont." Besides its direct value in increasing the efficiency of the cellular structure—providing, as it does, absolute assurance that bulkhead openings will be closed in time of danger—the adoption of the system results in a standardization of doors, openings, and parts of the operating mechanism. To put an end to the present endless variation in types and sizes of bulkhead doors and fittings is in itself a great advantage, and in time it is believed that these parts of a ship will be as thoroughly standardized as railway equipment is now. The cost of the electrical system is less than one per cent of that of the hull.

THE FIRST PRODUCER-GAS BOAT.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A short time ago we drew attention in the pages of the Scientific American to the development of the gas producer engine for marine purposes. The system described therein was that recently devised by Herr Emil Captaine, of Frankfort (Germany), which the inventor has applied to small vessels engaged in sheltered and still-water traffic on the European Continent with conspicuous success. As we mentioned at the time, Messrs. Thornycroft & Co., the well-known shipbuilders of London, have adopted the idea for more extensive application, and were at that time conducting several experiments with the system with a view to its installation upon a commercial or pleasure vessel. These efforts have now been brought to a successful issue, and at the recent reliability trials carried out in the Solent great interest was manifested in the vessel entered by Messrs. Thornycroft & Co., the engines of which depend upon fuel generated on the Capitaine suction gas producer principle.



THE "EMIL CAPITAINE," A 75-HORSE-POWER YACHT DRIVEN BY PRODUCER GAS.—THE FIRST OF HER KIND.

This is the first practical attempt to prove the commercial possibilities of the system for open-sea work. The first recorded instance of a vessel being propelled by an internal combustion motor is that which was made as far back as the sixties, when the Marquis d'Nare d'Aubaie's auxiliary yacht "Djesirèly" was fitted with a Lenoir motor. In this instance, however, the gas was not produced on board, but generated in a stationary apparatus on shore and stored on the vessel under pressure in cylinders.

The Thornycroft vessel, named "Emil Capitaine," in honor of the inventor, is a small yacht 60 feet in length by 10 feet beam, and with a draft of 2 feet 6 inches. The boat is designed upon the well-known Thornycroft lines which have been adopted in many of their boats with conspicuous success. The stern is broad and flat, and the single propeller works in a tunnel, thereby insuring great steadiness in running without causing the stern to settle down unduly, and further causing a clear and unobstructed flow of water to be maintained to the propeller. The hull is constructed of galvanized steel plates. Roomy accommodation is provided, there being two saloons, one forward and one aft, respectively. The machinery is installed just forward of the aft cabin, between watertight bulkheads.

The suction gas producer plant, together with the specially designed engine for working with the same, have been built by the Thornycroft Company from the designs of Herr Emil Capitaine. The motor is of the inclosed vertical type, having four single-acting cylinders, each having a bore of 8½ inches with a stroke of 11 inches running at a normal speed of 300 revolutions per minute.

The special designs involved in the construction of this engine may be gathered from the following description of the plant. The engine frame is comprised of mild steel plates connected by angle bars, so that a box-like structure is provided, of great rigidity. The crank pit is formed by carrying the steel plates right around. The cylinder trunks are each cast separately and are contained in the framing. The cylinder heads are also cast separately and are supported between plates riveted to the transverse members of the frame. The result of this design is that the latter plates serve to absorb all the shock of the explosion which is transmitted directly to the crank-shaft bearings, which are also bolted to the frame plates. Heavy bolts for the purpose of connecting the cylinder heads to the trunk, which practice is usually adopted in this type of combustion motor, are thereby dispensed with, while possibility of leakage is reduced to the minimum. This principle also renders the engines more accessible, it being possible to remove all the mechanism concerning the ignition and valves with facility and celerity when it is requisite to carry out cleaning, inspection, or other operations. In fact, the gearing can be disconnected and replaced within the short space of six minutes.

All valves are mechanically operated by cams, the latter being actuated from the crank shaft by means of suitable gears. The cam shaft is placed above the top of the cylinders and slightly out of the center line, the motion being imparted to the valves through rocking levers. The cam shaft is hollow and carries in it a sliding shaft which, by means of radial arms projecting through slots in the cam shaft, operates the strikers of the low-tension magneto igniters. The longitudinal motion of this internal shaft, which is controlled by the governor of the engine, varies the time of ignition, advancing or retarding it as the speed of the engine increases or decreases. There is also an arrangement introduced whereby the timing of the magneto machine is simultaneously varied to correspond with the point of ignition. The engine itself is controlled by means of a throttle valve in the induction pipe connected by a special device to the governor. There is furthermore provision for completely cutting out the electrical circuit when the speed of the engine exceeds a certain limit.

The engine is fitted with half compression gear for starting purposes. The latter function is carried out by means of a separate single-cylinder Thornycroft motor of 6 horse-power through a belt drive. The half-compression cams are automatically thrown out of action by means of an attachment fitted to the governor when the motor reaches its normal running speed. The cylinder heads are water-cooled, the circulation being carried out with a centrifugal pump driven off the engine. The exhaust is also water-jacketed, and the gases escape into the outer atmosphere through a funnel, thereby dispensing with a silencer. Forced lubrication is adapted to all bearings by a specially designed reciprocating oil pump. Access to the bearings of the crank shaft and connecting rods of the pistons is obtained through doors fitted in the lower part of the engine. At the forward end of the crank shaft is a pulley for driving a gas drier and a centrifugal pump for pumping the heated and dirty water from the gas purifier. Reversing is carried out by means of epicyclic gear and a cone clutch placed in the line of shafting forward of the thrust block. The engine is freed and reversed in either direction by a single hand wheel.

The suction gas producer is of the ordinary cylindrical shape, comprising a steel shell with a firebrick lining surrounding the hot zone. The fire bars are of channel section to enable them to withstand better the intense heat and also to hold the ash. They are carried on cams and can be lowered toward either side to facilitate clinkering. There are three charging doors in the top which deliver into a conical annular hopper, while in the lower part are provided the usual air and steam inlets. The steam generator is placed in the upper part of the producer and comprises a shell with field tubes. This serves the dual function of cooling the gases and generating steam which is decomposed in the fire in order to supply the necessary gases for the explosive mixture. An ingenious alternative arrangement is fitted whereby the steam may be generated by the exhaust gases from the engine. After production the gas passes into a cooling tower in which

a spray of water falls by gravity from the top, while a finely divided spray of water is also injected into the bottom part of the tower by compressed air. Any impurities that may be impregnated in the gas are thus completely arrested. No solid material, such as is usually required in the scrubber, is employed, and this arrangement forms a conspicuous feature of the apparatus.

The facilities for drying the gas thoroughly and at the same time removing any traces of tar that may have escaped through the cooler constitute a prominent characteristic of the plant. It is absolutely essential for the most efficient operation of the engine that every trace of moisture should be removed from the gas, and this drying is effected by means of the centrifugal drier which is driven off the engine through a belt transmission as previously mentioned. This drier is made to run at a high velocity. A double-seated valve is fitted in the induction pipe near the engine for mixing the gas with air, the proper mixture being automatically regulated according to the speed of the engine. Should, however, a richer proportion of gas or air be desired, this can be regulated by hand. The hopper of the gas producer carries sufficient anthracite for a 10 hours' run at a speed varying from 10 to 12 miles per hour. The installation occupies but little space, the whole plant being contained in a floor area of 12 feet 6 inches by 9 feet 4 inches, while the maximum height is 6 feet 8 inches.

Unfortunately, owing to the short time which was available between the launching of this boat and the reliability trials in the Solent, it was impossible to make any preliminary runs for tuning-up purposes. The yacht was towed round from the Thames to the scene of the trials and entered at once in the contest. On the first day she proved highly successful, making a nonstop run for the whole 10 hours of the trial. During this time she covered the sheltered course six times and the open-sea course once—a total distance of about 80 miles—in 9 hours 12 minutes. This gives an average speed of 13.04 miles per hour which, considering all circumstances, was highly satisfactory. The boat, however, is capable of much higher speed, though it has not been constructed for fast running. During this 10 hours' run 467 pounds of anthracite was consumed, representing a cost of $1.08. The low cost of running a vessel with this type of fuel is thus conclusively demonstrated, since no other system can compare so favorably with it. On this basis it will be seen that a ton of coal would be sufficient for nearly two days' cruising at 13 miles an hour.

On the second day the vessel broke down, owing to the bearings of the water-circulating centrifugal pump seizing through a slipping belt. Still it was recognized that the vessel had justified the builders' anticipations and its future possibilities from a commercial point of view were realized. In recognition of the Thornycroft company's efforts to adapt the suction producer gas type of motor to marine purposes a special gold medal was awarded to them.

The trials proved that the gas engine in conjunction with a suction gas producer if properly designed is the most economical generator of power yet devised. The consumption of anthracite works out as low as 1 pound of fuel per brake-horse-power per hour. A compound condensing steam engine consumes from 1 1-3 to 3 pounds of fuel per brake-horse-power per hour according to size and type, while with the oil engine the consumption is approximately one pint of kerosene per brake-horse-power per hour. Anthracite costs only about $4.75 per ton, while on the other hand, kerosene costs about $30 for the same quantity. The respective cost of fuel per horse-power-hour for the three systems works out approximately as follows:

For the oil engine .... 1.47 cent
For the average steam engine...... 0.42 cent
For the producer gas plant........ 0.21 cent

—showing that the advantages in economy and relative efficiency are completely in favor of the suction producer gas engine. Messrs. Thornycroft & Co. have arranged to carry out a series of trials in the open sea upon the measured mile with the "Emil Capitaine" when she has been tuned up, and the experiments will be closely followed by all marine engineers both for commercial and naval purposes. Already the patents have been acquired for extending the system to large vessels by another prominent British shipbuilding firm, the Thornycroft company confining their efforts to its application to the smaller type of craft.

The use of superheated steam in locomotives does not entail the multitude of practical difficulties that so generally accompany any invention or improvement that is introduced to improve the economic results obtained from a locomotive, and indeed, it is probable that as experience with its application develops, some of the expenses that are incurred in the locomotive of to-day will be diminished rather than increased. There would only appear to be two possible sources of additional cost, the wear of valves and cylinders due to defective lubrication, and the cost of maintaining the superheater itself.

A GOVERNMENT-BUILT BATTLESHIP.

It takes but a glance at the handsome engraving that forms the front page of this issue to be convinced that the policy of the government in placing the order for the construction of the battleship "Connecticut" at the government yard was a far-sighted act that has been abundantly justified by the results. When we bear in mind that the keel of this, the largest battleship afloat, was laid in March, 1903, and that she will be ready for her official trials during the spring of next year, we can see that in the construction of this ship, the Navy Department has buried once and forever the old popular fiction that the construction of warships in a government yard is necessarily slow and expensive, and the work indifferently done. For the origin of this popular impression, we have to go back some twenty years or more to the date of the building of the two second-class battleships "Maine" and "Texas," both of which took a long time to build and cost an unconscionable sum of money. The cause was to be found in the fact that at that time the government yards were largely dominated by political influence. "Pull" was rampant, and the hands of the naval constructors were tied, or if not tied, were at least greatly hindered by the fact that incompetent and lazy employes who believed that political influence would prevent their discharge, were to be found in every yard and in every department at these yards.

The breaking up of the political system was due mainly to efforts of the naval constructor at the Norfolk yard, who subsequently, on coming to New York, became an ardent advocate of the construction of some of the new warships at the more important government yards. He argued that the yards having been rid of political interference and brought up to a high state of efficiency, ships could be built with greater expedition, with equal thoroughness, and for but very little greater cost than they were at private shipyards. Furthermore, it was urged that by having a government ship always on hand at the more important yards, it would be possible to maintain a large and efficient staff of workmen constantly in government employ, instead of being under the disastrous necessity of discharging a large proportion of the force when the annual repair work on the ships in commission was completed.

Congress very wisely determined to give the matter a trial, and of the two sister battleships authorized in the same year, one was given to a private yard, and the other to the Brooklyn navy yard, New York.

The results thus far achieved have more than fulfilled expectations. The "Connecticut" has not only been built faster, and considerably faster, than any previous battleships constructed for our navy, but she is to-day slightly ahead of the sister ship at the Newport News yard, and this in spite of the fact that great enthusiasm prevails at the southern yard, and there is an unspoken understanding among the workmen to push the boat along and have her completed ahead of the government-built ship. In the report of August 1 of this year, the "Connecticut" was 0.83 per cent ahead of the "Louisiana." During the month she was advanced 2.48 per cent toward completion, so that on September 1, 86.15 per cent of the work was done. The indications are now that she will be ready for her preliminary trials in the spring of next year, and ready for her final sea trial two or three months later.

Perhaps the most valuable result of the successful construction of the "Connecticut" is the stimulating effect which it has had on government work in the private shipyards. At the time that the building of the "Connecticut" was commenced, the five battleships of the "Georgia" class were making very slow progress, indeed. The act of Congress authorizing these five ships was passed on March 3, 1899. Three years later, on July 1, 1902, was passed the act authorizing the building of the "Louisiana" and "Connecticut." On August 1 of the present year, the "Nebraska," one of the ships authorized in 1899, was only 77 per cent completed, the "Georgia" 85 per cent, and the "New Jersey" 87 per cent; while the "Connecticut" and the "Louisiana," in spite of the three years' handicap, were respectively 83.67 and 82.81 per cent advanced toward completion. The stimulating effect of the "Connecticut" upon the construction of other ships is shown in the case of the three battleships "Vermont," "Kansas," and "Minnesota," practically sister ships of the "Connecticut," which were authorized in March, 1903, and are already respectively 57.1, 57.8, and 69.9 per cent completed.

The argument in favor of government-built ships, based upon the fact that there is not sufficient repair work in the yards at all times to keep a large force constantly employed, does not have the force that it did six or eight years ago, when our navy was considerably smaller. At the present time there are few months of the year when the navy yards, and particularly the larger ones like that of New York, are not well supplied with ships that are undergoing refitting and repair. No doubt ultimately we shall reach a point where repair work alone will keep our present navy yards thoroughly busy all the time. But until that point is reached, we think it would be advisable, in view of the good results obtained in the "Connecticut" experiment, to have at least one warship upon the stocks at all times at our principal navy yards.

Correspondence.

The Lunar Rainbow.

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest the different discussions concerning the lunar rainbow in some recent issues of your paper, and would say that, in some respects, I quite agree with your correspondent, Mr. Harry Clifford Doane. Although the occurrence of the so-called lunar rainbow may be comparatively rare, I, too, think that the phenomenon is not generally known because of lack of observation. Before coming to this country I often had occasion to witness lunar rainbows, and I think I can give some explanation as to their origin.

The city of Luxembourg (Grand-Duchy of Luxembourg) is situated at an altitude of over three hundred meters above the sea level and a peculiarity of the air of this city is, that during the greater part of the winter, the atmosphere seems to contain an exceptional amount of humidity. Now, I can recall that I saw lunar rainbows quite often during the winter in that city, and always under the same circumstances. I never saw a bow unless the moon was full or very near its fullness. The air was always hazy and misty and very humid. I [illegible] saw the phenomenon before 11 P. M. or after 1 A. [illegible] The moon was then always very high. As far as I could see, the diameter of the bow which surrounded the moon sometimes was five and sometimes ten times that of the moon. I always could plainly distinguish the spectrum colors, but never saw them as brilliant or perfect as those of the solar rainbow; probably the mist is a little too dense. Also the color band of the bow seemed to measure only half that of the solar rainbow. This is doubtless due to the great distance of lunar bows from the earth.

My own theory as to the formation of the lunar bows is as follows:

The moon rays, upon entering our atmosphere, will be refracted to a certain degree, and after traveling further touch the dense layer of the humid air. As very humid air is nothing else but rain in a very minute form, the moon rays will be refracted in the millions of small water drops and will form a bow similar to the solar rainbow, which we know takes place under quite analogous circumstances.

I do not think that lunar bows can be formed in an absolutely dry atmosphere. HUCK GERNSBACK.

New York, August 29, 1905.

The Largest Dam in the World.

To the Editor of the SCIENTIFIC AMERICAN:

In the very interesting article that appears in your issue of July 1, on the subject of the Wachusett reservoir, it is claimed that this is "by far the largest freshwater reservoir in the world."

This statement is evidently made under the misapprehension that the largest reservoirs in India are those shown in the list (on page 11) in the article in question. Those lakes there mentioned are merely those in the Bombay Presidency, and do not include the largest in India.

In the native state of Udaipur in Rajputana, some 30 miles south of the city of Udaipur, is the great Jaisamand, the Dhebar lake. The dam of this lake was built some 200 years ago by the Maharana Jai Singh to rival the beautiful and extensive lake built by his predecessor at Rajnagar, 60 miles further north.

This lake covers an area which, according to careful planimeter measurements from the 1-inch-to-the-mile topographical maps, is 25 square miles. The old and now out-of-date Imperial Gazette I see, however, speaks of it as 21 square miles, so I will take this figure.

The depth of water at the dam is 90 feet. The average depth of the water is not known, but assuming that it bears somewhat the same ratio to the height of the dam as the lakes given in your list do, the average depth would be roughly 35 feet—a not improbable figure.

Taking this average depth and 21 square miles of area, this lake would have a volume of 2.43 times as much as the Wachusett reservoir, and holds therefore $2.43 \times 63 = 153$ billion of gallons.

This lake is a remarkable one in many ways, but is unfortunately in a very inaccessible part of the country and is therefore not very well known.

The dam is only about 1,000 feet long and is of the style favored by those old chiefs of Rajputana. It consists of two massive and ornamental masonry walls some 500 feet apart with the space between filled in with earth and ornamented with gardens.

The overflow is not provided for in the dam at all, but some five miles off at the end of a spur in the range of hills, and consists merely of a light cut.

I send you this information, as it may be of interest to your readers. G. E. LILLIE,
Divisional Consulting Engineer for Railways.
Government of Bombay, Public Works Department,
August 4, 1905.

HYDRAULIC SUCTION DREDGE ON THE MISSISSIPPI.

BY DAY ALLEN WILLEY.

The hydraulic suction dredge in use on inland waters of the United States has been employed extensively only within the last ten years; but such has been its development, that a revolution in the methods of deepening river channels has resulted from its service. The construction of what engineers term the "Greek letter" series of dredges marked the beginning of a new era in controlling the channel of the Mississippi, and undoubtedly the work done by this type of excavating machinery is responsible for the dimensions of the present boat channel.

The problem presented to the United States engineers by the Mississippi River has been one of the incentives which has led to the designing of the modern suction machine, not only for inland waters, but for the excavating of deep-sea channels such as the entrance to New York harbor. The "Alpha," "Beta," and other dredges of this type, constructed for the Mississippi service, have a number of points in common with the excavators which are employed upon the New York improvement, but were designed for use in comparatively shallow water, and to remove a wide area of the bottom of the river.

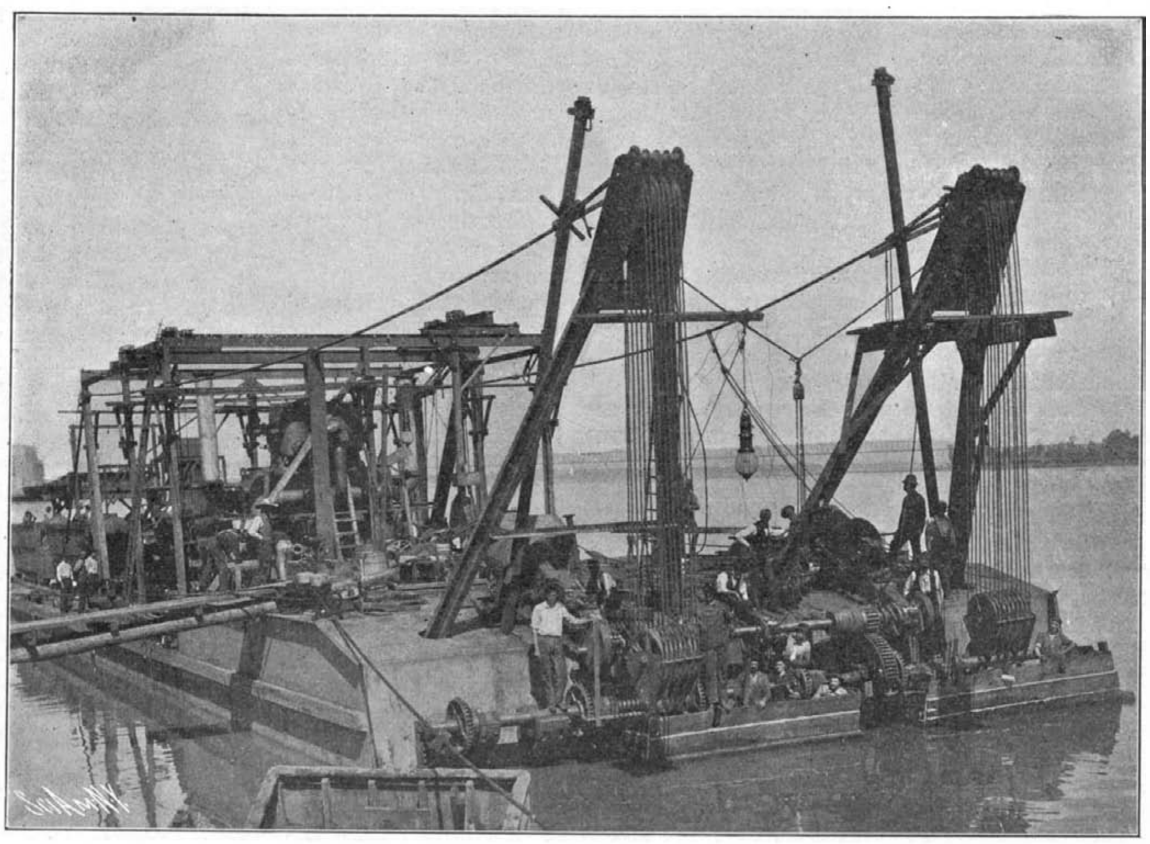
The accompanying illustrations give an excellent idea of the arrangement of the pumping and other machinery on the Mississippi dredges, being photographs taken at the time the mechanism was installed on the "Beta," one of the largest of the Greek letter series. At the time it went into commission the "Beta" was by far the most powerful suction excavator employed anywhere on inland waters, and for several years had the greatest capacity of any of the Mississippi suction machines. The dredge really consisted of two inclosed in one hull, each being provided with its individual pump, conduits, and other connections, so that one section of the dredge could be operated independently of the other. The hull, which was built of steel, was 172 feet in length, 40 feet in width, having a depth varying from 7 1-6 to 10 5-6 feet. The apparatus, which was constructed by the Maryland Steel Company, at Sparrow's Point, and placed in the hull at Cairo, Ill., includes two triple-expansion pumping engines having cylinders of 20½, 33, and 38 inches respectively with a 24-inch stroke, the engines being provided with jet condensers. The pumps are located amidships, each having a runner of seven feet diameter with a shaft of ten inches diameter. The discharge is of the enormous size of 33 inches, and the suction 33¾ inches in diameter. Each suction pipe is provided with three heads of 19½ inches in diameter, making the combined diameter of the suction heads nearly five feet. At the ends of the suction pipes are placed cylindrical cutters five feet in diameter, which have a speed of 25 revolutions a minute, being operated by a separate engine placed on the bow of the dredge.

The pumps, which are driven at the rate of 125 to 130 revolutions per minute, discharge the material through a steel conduit ranging from 1,000 to 1,200 feet in length, according to the location of the dump from the vessel. This conduit is made in 50-foot sections, with flexible connections of rubber hose. It is supported on a series of steel pontoons, and is extended forward on the craft, and is usually placed up-stream from the dredge, advantage being taken of the current in controlling the movements of the latter when in service. The upper portion of the suction apparatus is also buoyed on a pontoon attached to the bow, in order to partly relieve the strain caused by the weight of the pipes when carrying material. The suction conduits are raised and lowered by arms projecting obliquely from the hull, each arm supporting a block through which are passed cables attached to each conduit. By this method the suction apparatus can be immediately lifted from the water, when it is necessary to change the position of the dredge or to perform some other service.

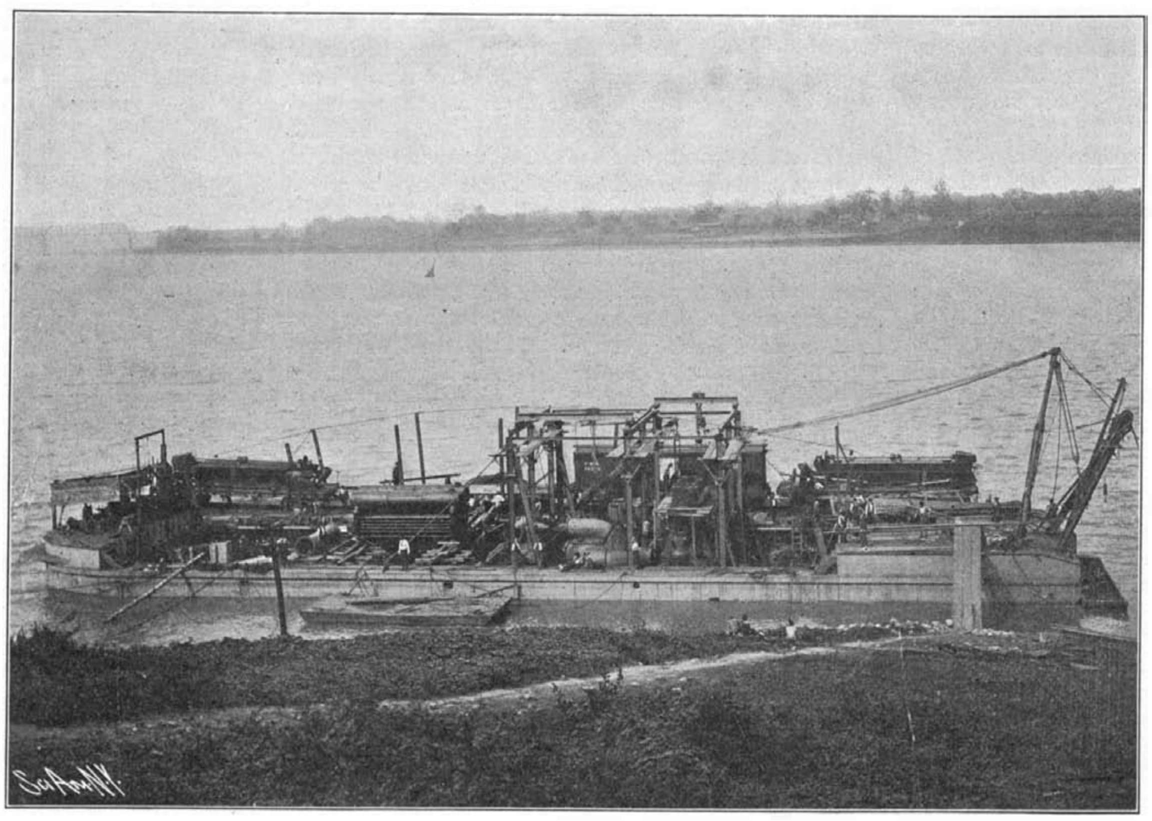
Steam is generated on the "Beta" by a battery of four boilers, each representing nominally 375 horse-power. Steam is not only employed for driving the pumps, but for operating an electric-light plant for working at night and for several other auxiliary purposes. When in operation the dredge is held in position by two vertical spuds set astern, which are controlled by a three-drum hoisting engine.

Considering the dimensions of the suction and discharge pipes, and the high power of the pumping engines, it was expected that the dredge would be capable of removing a much greater quantity of material than any other type of river excavator that has yet been employed in this country. But a test of the service showed that the capacity had been underestimated rather than overestimated; for on ordinary work the "Beta" has removed 5,000 cubic yards of sand in a single hour, discharging it at a distance of at least 1,000 feet from the excavation. While many of the shoals on the Mississippi consist principally of sand, at times clay and formations are encountered so hard that the use of the cutter is necessary. It has been found with this attachment, however, that a dredge of the "Beta" type can work on practically any portion of the stream, except where snags or some other unusual obstacle exists.

One of these suction dredges and its auxiliary craft represent a small fleet of boats. The "Beta" usually requires two towboats to move it from shoal to shoal, as well as a pile driver, two river barges for carrying the discharge pipe and other material, as well as a barge which has been fitted up for a combined blacksmith and machine shop. To operate the dredge proper and the discharge pipe requires a crew of about sixty men; but estimates made of the cost of excavation by this method compared with other plans which have been employed upon the Mississippi, show that it is far more economical, owing to the much larger quantity of material which can be removed in a given time.



Detail View of Bow Section of Dredge, Showing Elevators for Raising and Lowering the Pipe.



General View of the Dredge Machinery.

HYDRAULIC SUCTION DREDGE ON THE MISSISSIPPI.

THE NEW SOLAR OBSERVATORY AT MOUNT WILSON.

BY M. BENEDICT MAYE.

In 1903 Dr. Hale went up to Mount Wilson, and began his new solar observatory. The following spring an expedition for solar research was organized under the joint auspices of the University of Chicago and the Carnegie Institution for the Promotion of Science with the understanding that the Carnegie Institution furnish the funds for the construction of piers and buildings and other expenses incidental to the work, while the University of Chicago furnished equipment and paid the salaries of some of the members of the party.

The Carnegie Institution has granted the sum of $150,000 for use during 1905, which will cover about one-half the cost of the first equipment, with the understanding that should the Carnegie Institution decide to establish a solar observatory of its own, this should take the place of the Mount Wilson station of the Yerkes Observatory and the work be continued under the sole auspices of the Carnegie Institution.

Dr. Hale, who is now president of the Society for International Co-operation in Solar Research, which numbers its members from every civilized country on the globe, has already outlined the plan of research and determined the equipment of two other observatories, the Kenwood—subsequently merged with the Yerkes—and the Yerkes Observatory of Chicago, and he regards the instrument shop of great importance, since it renders possible the construction and frequent improvement of instruments of new type and special design. The operation of the shop is not confined to the construction of the mechanical parts of the instruments; provision is also made for optical work on a large scale.

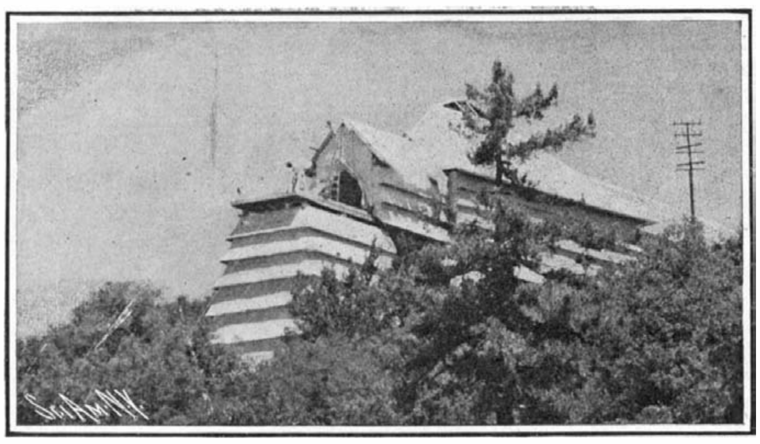
This shop is located at Pasadena, and is 50 by 100 feet, with an optical testing room 150 feet long extending 68 feet beyond it in the rear. It is fireproof, as the optical and mechanical parts of the instruments under construction are very valuable. It contains offices and drafting rooms, machine shop, instrument shop, pattern shop, lacquer room, constant temperature room, room for 5-foot grinding machine, room for 40-inch grinding machine, long optical testing room, photographic dark rooms, enlarging rooms, etc. The equipment includes milling machines, planes, lathes, grinding machines, drill presses, various saws, trimmers, and all other tools needed. The optical laboratory will contain all necessary machinery for grinding, polishing, and testing mirrors with apertures as great as 5

feet and focal lengths as great as 150 feet. Some of the delicate machines are marvels of ingenuity and are the inventions of the director and superintendent. This machine shop at Pasadena saves the hauling of much raw material up the mountain, but a shop at hand is necessary for immediate repairs of instruments already installed, so a building 15 by 35 feet is equipped as small power house and repair shop with 15-horsepower Witte gasoline engine, dynamo, etc., located on the mountain near the laboratory.

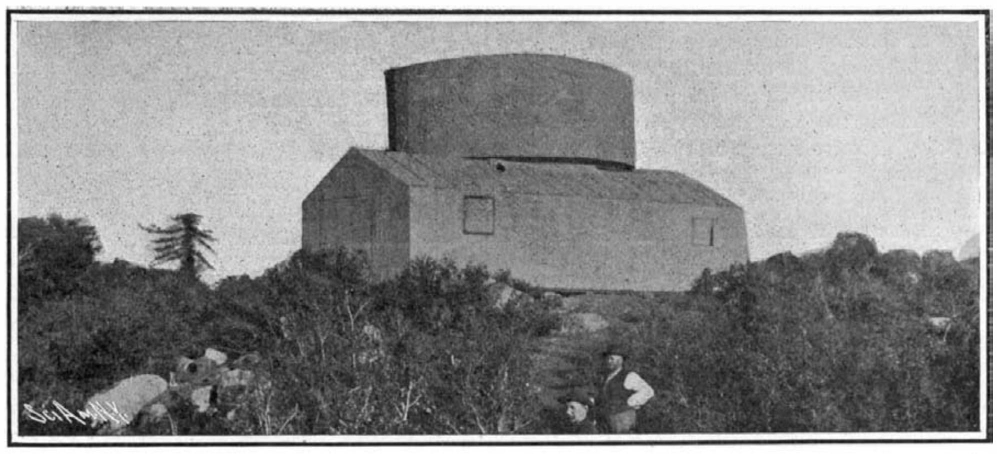
Stone is found on the mountain, but all other building material and all supplies and instruments have been carried up the narrow winding trail on the backs of donkeys, with the exception of the equatorial head of the instrument, weighing about 400 pounds, which was carried up by a specially improvised truck with narrow body and rubber-tired wheels. A sort of one-mule "automobile" has since been constructed from this to meet the requirements of the narrow trails and the character of the loads to be conveyed.

To date over 175 tons have been carried up the mountains by the donkeys, and daily the loaded pack trains make trips, each donkey well loaded, and wearing a cage somewhat resembling a baseball mask to prevent him feeding by the wayside. Half a dozen or more are sent up the winding trails with a driver on horseback to guide them and keep them moving. The leader wears a bell, the tinkle of which warns others coming down on the trail, as it is so narrow there is room to pass only at certain points.

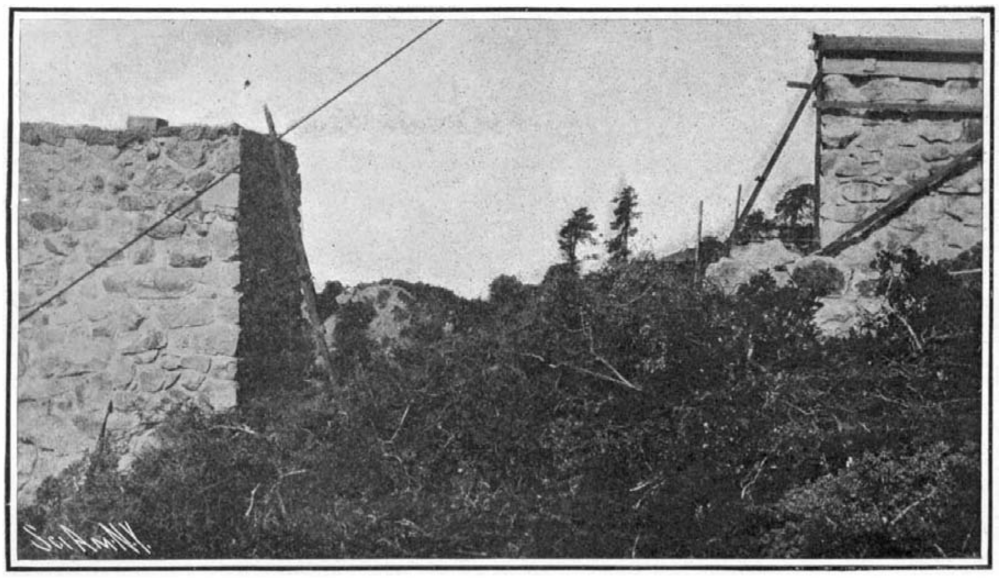
The electricians are just completing the wiring of the buildings of the observatory. It has been a work of half a year for nearly a dozen skilled electricians and many hundred feet of wiring as well as many dynamos have been set up. It is all expert work, often requiring very delicate manipulation.



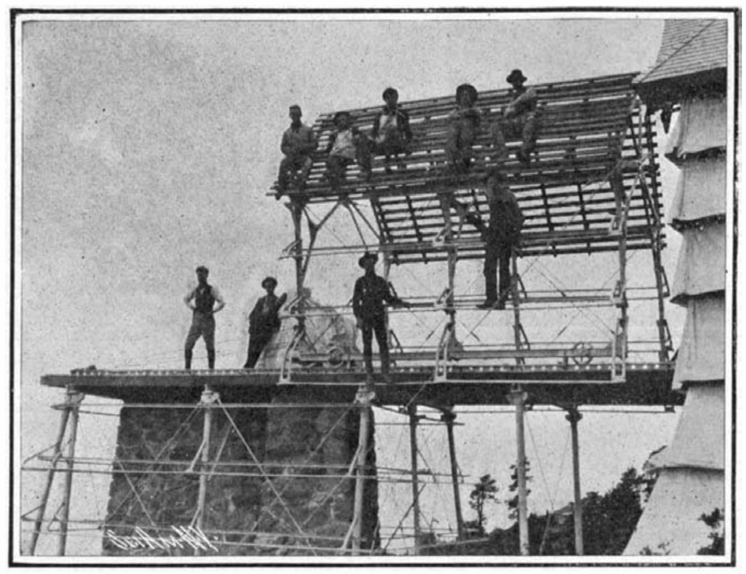
Front of the Snow Horizontal Telescope.



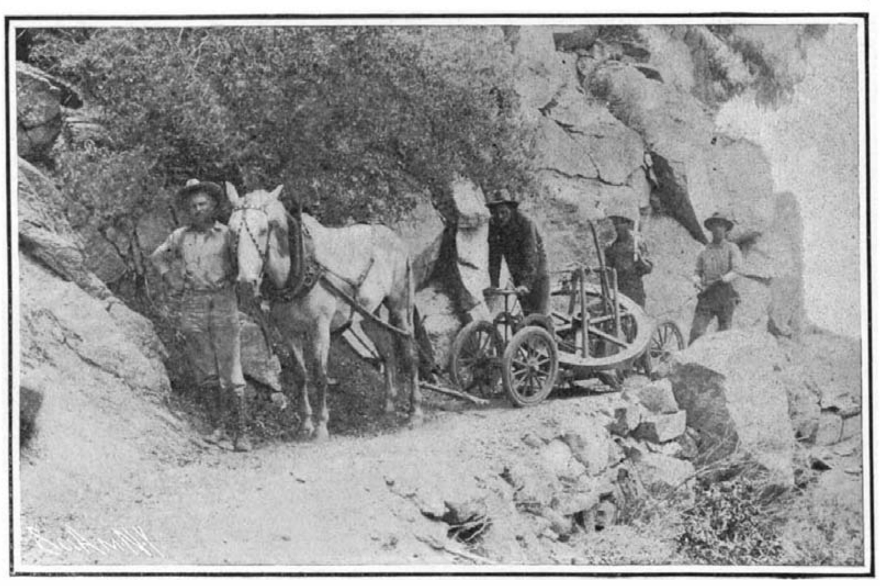
The Original Observatory on Mount Wilson.



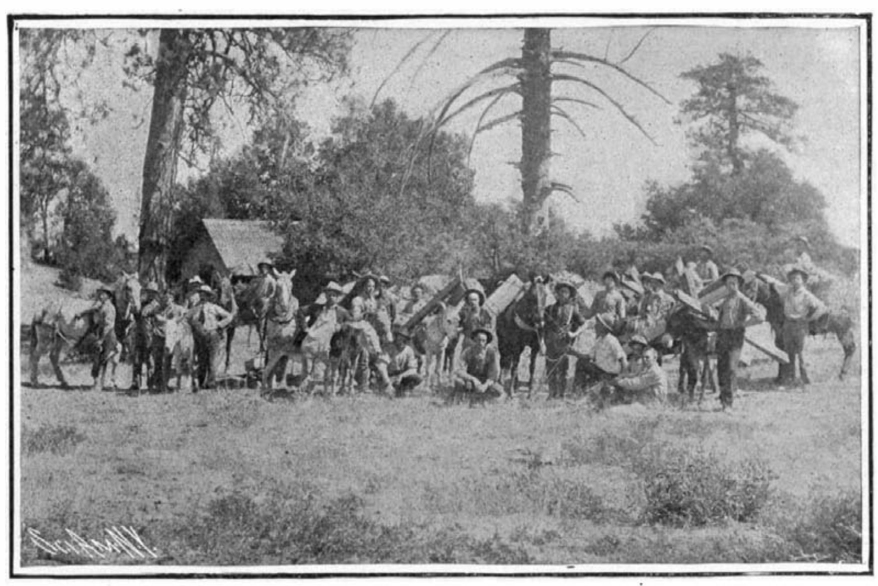
The Two Piers of the Snow Telescope.



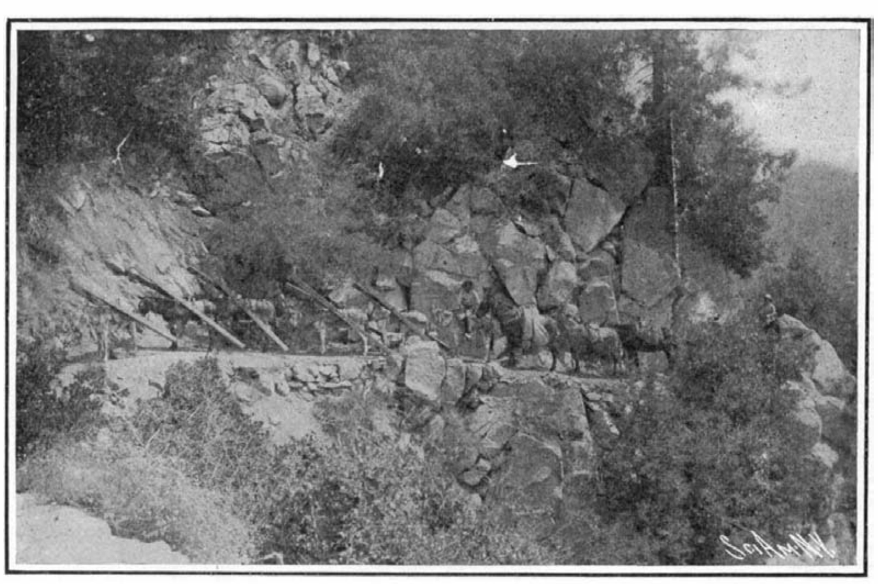
Head of Snow Horizontal Telescope in Course of Construction.



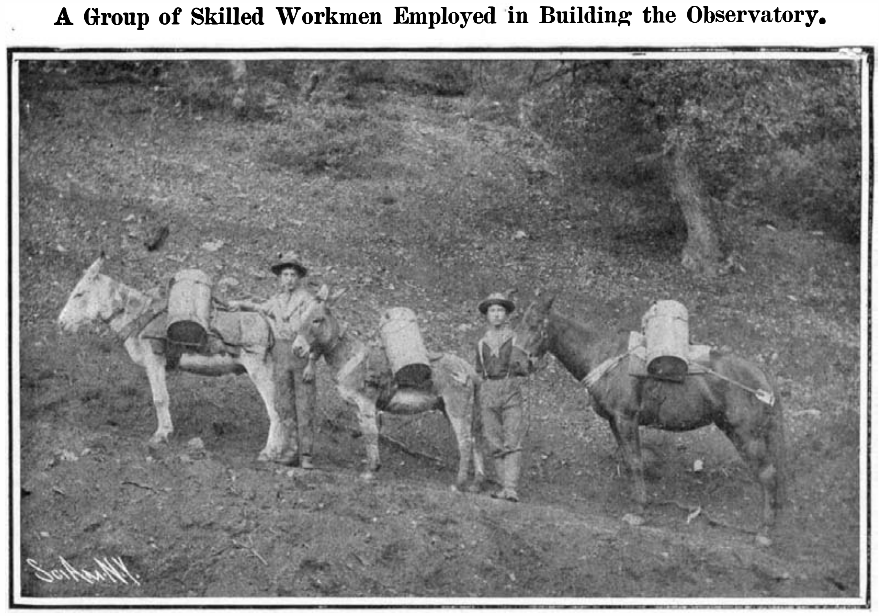
How Heavy Parts of the Instruments Were Carried up the Trail.



A Group of Skilled Workmen Employed in Building the Observatory.



Pack Train of Lumber and Cement for Constructing the Solar Observatory.



Packing Water for Mortar to be Used in Building the Observatory.

THE NEW SOLAR OBSERVATORY AT MOUNT WILSON.

The foundations of the new laboratory are well under way, and the building is going up rapidly. It will be located just below the large Snow telescope, between that and the machine shop, and will be well equipped.

The Snow horizontal telescope with its multitudinous attachments is installed in a building 200 feet in length, especially designed to maintain an even temperature with reduced heating and radiation. The walls, supported by a steel framework, are composed of canvas which has been covered with fireproof paint, and are made in horizontal sections overlapping each other, so that a current of air goes through the opening between, yet do not admit light or rain. This gives them the appearance of scales, and the long, narrow structure with its lofty headpiece presents to the wondering tourist something of the appearance of a Chinese dragon spread out on the top of the mountains among the trees. The peak on which it rests slopes abruptly down on all sides, and large trees grow near, so that it is difficult to get a photograph of the building entire.

The Snow horizontal telescope is a cœlostat reflector, about 16 inches in diameter, showing wonderful detail. The great Yerkes telescope with a 40-foot object glass and a 64-foot focus produces an image of but 7 inches in diameter; thus the great advantage of this Snow telescope with its 145-foot focus and 16-inch image of the sun is at once apparent.

The spectroheliograph is 7 inches aperture and 30 feet focal length. The dispersive of this instrument consists of three prisms of 45 deg. retracting angle used in conjunction with a plane mirror so as to give a total deviation of 180 deg. The motion of the solar image, of which a zone about 4 inches wide can be photographed with the spectroheliograph, will be produced by rotating the concave mirror about a vertical axis by means of a driving clock.

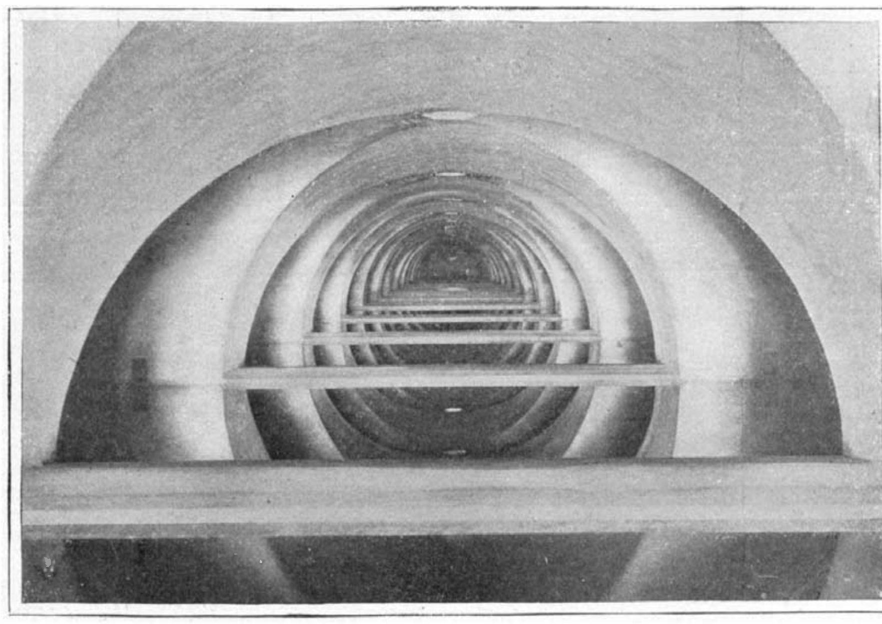
A second driving clock, controlled by electricity so as to be synchronous with the first, will move the photographic plate behind the second slits. Three slits will be provided at the front so as to permit photographs to be taken simultaneously through as many different lines of the spectra.

tographic investigations with the 5-foot reflector should throw light on the past and future condition of the sun. All of the principal researches will thus be made to converge in the problem of stellar development.

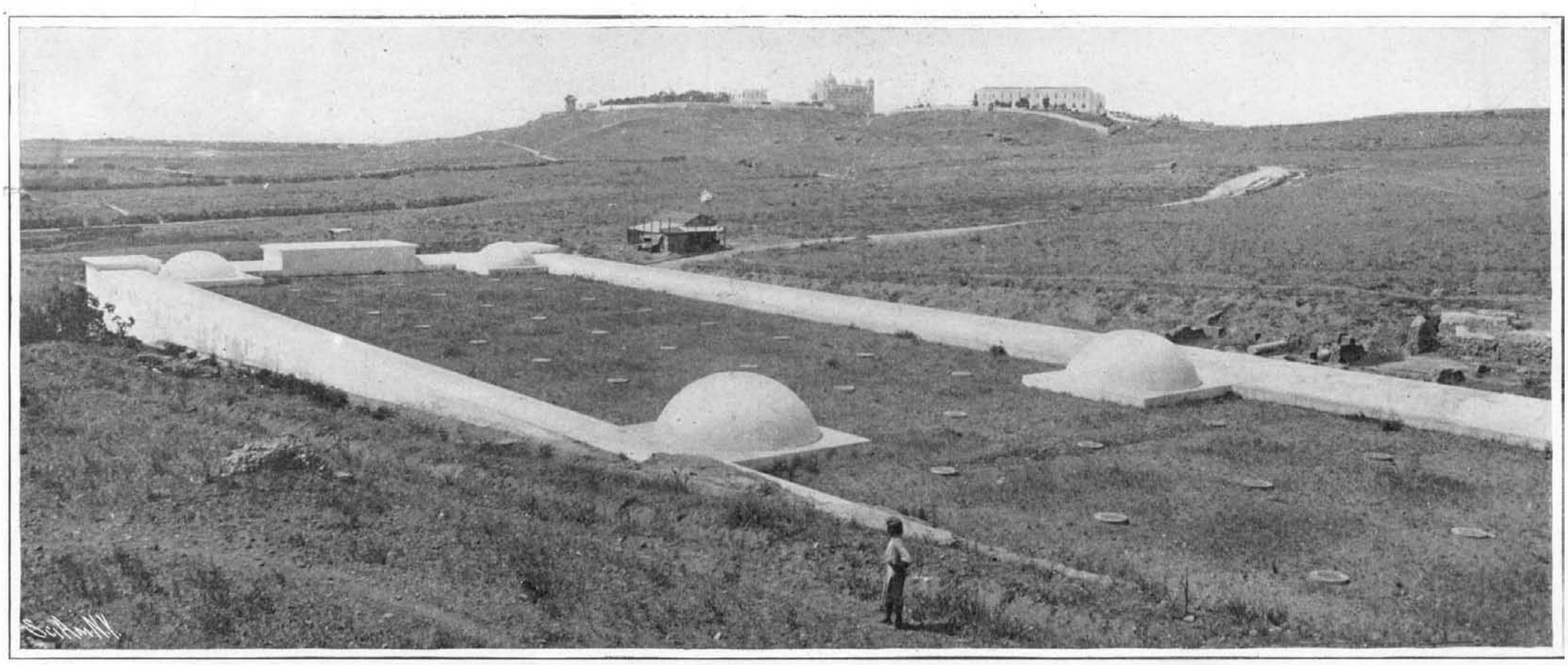
With this new solar observatory for the more complete realization of laboratory conditions in astrophysical research, through the employment of fixed telescopes of the cœlostat type, and the adoption of the Condi mounting for the 5-foot reflector, mirrors of great focal length may be used, providing a large image of the sun for study with spectroscopes and spectroheliographs; also long-focus grating spectroscopes mounted in a fixed position in the constant-temperature laboratory may be used for photographing stellar spectra requiring very long exposures, and radiometers may be used which cannot be employed in conjunction with moving telescopes.

Another object is the development of the spectroheliograph in the various directions suggested by the recent work of the Yerkes Observatory, including the photographing of the entire solar disk with dark lines

Reservoirs of La Malga.



Within the Bordj-Djedid Reservoirs. One of the Chambers Filled with Water.



Reservoir of Bordj-Djedid Restored. Showing Part Which Now Lies Above Ground, the Cupolas and the Openings from Each Cistern. In the Rear is the Height Formerly Occupied by the Citadel of Carthage.

ANCIENT RESERVOIRS AT CARTHAGE.

the cœlostat mirror having a diameter of 30 inches. A second plane mirror 24 inches in diameter reflects the beam from the cœlostat north to either one of two concave mirrors each of 24 inches aperture. One of these concave mirrors, of about 60 feet focal length, is to be used in conjunction with a solar spectrograph of 5 inches aperture and 13 inches focal length. A spectroheliograph of 7 inches aperture resembling the Rumford spectroheliograph of the Yerkes Observatory, and a stellar spectroscope provided with a large concave grating, are mounted in the constant-temperature laboratory.

It is hoped to photograph the spectra of a few of the brightest stars. For fainter ones the spectrograph is to be provided with several prisms for use singly or in combination.

The second concave mirror of the cœlostat reflector is designed to give a large focal image of the sun especially adapted for investigations with a powerful spectroheliograph and for spectroscopic studies of sun-spots and other solar phenomena. The focal length of this mirror is 145 feet, so that it will give a solar image of

Prof. E. E. Barnard, professor of astronomy of the University of Chicago and Yerkes Observatory, who is noted for his many discoveries and beautiful celestial photographs, has charge of the Bruce telescope, which was shipped to Mount Wilson from the Yerkes Observatory last December. It is intended to use the lower latitude of Mount Wilson to reach the regions of the Milky Way which are not attainable from the latitude of the Yerkes Observatory, and to secure photographs of them, and also of some of the great diffused nebulosities which are more or less cut out by the denser air at lower altitudes.

The first object of this new solar observatory is to apply new instruments and methods of research in the study of the physical elements of stellar evolution. Since the sun is a star near enough to the earth to permit its phenomena to be studied in detail, special attention will be devoted to solar physics, and it is hoped that the knowledge of solar phenomena thus gained will assist to explain certain stellar phenomena. Conversely, the knowledge of nebular and stellar conditions to be obtained through spectroscopic and pho-

of hydrogen, iron, and other elements; further application of the methods of photographing sections of flocculi corresponding to different levels; special studies of sun spots, and daily routine records of calcium and hydrogen flocculi and prominences.

A 5-foot equatorial reflector will be constructed with Condi mounting and used in photographing nebulæ, the study of stellar and nebular spectra, and the measurement of the heat radiation of the brighter stars.

In addition to the above, provision will be made for various laboratory investigations necessary in conjunction with solar research. Suitable magnetic apparatus will be installed in order to secure complete record of solar phenomena when storms are in progress.

ANCIENT RESERVOIRS AT CARTHAGE.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

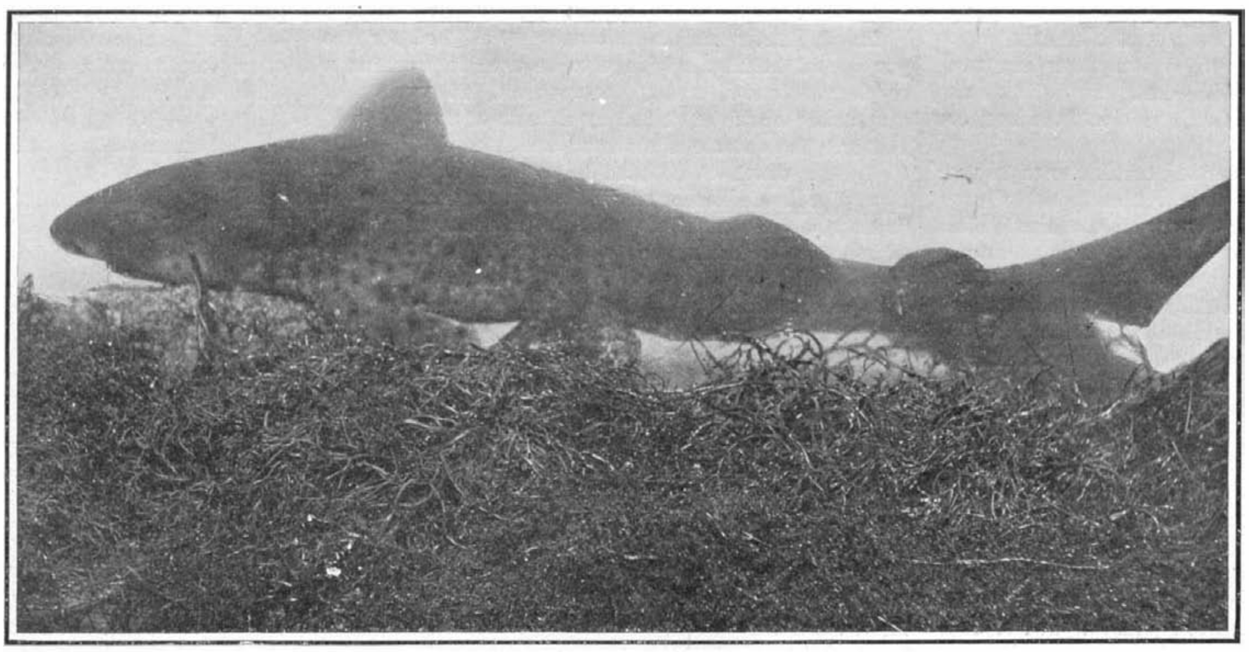
Ancient Carthage depended almost entirely upon rain water for its supply, as the aqueduct which brought the water from the mountains at Zaghouan was only built in later times by the Romans. Excavations show us that the streets, the squares, and the

courts of the houses were paved with large flagstones, and this was done so as not to lose any of the precious fluid. A series of conduits led from the sewers to the immense reservoirs which were placed in the lower part of the city. When we dig down to some depth in the ground we can still find the flagstones in place under the layer of ashes coming from the time when Scipio's soldiers burned down the city.

One of the large reservoirs lies near the shore in the lower part of the city and not far from the old Turkish fort of Bordj-Djedid.

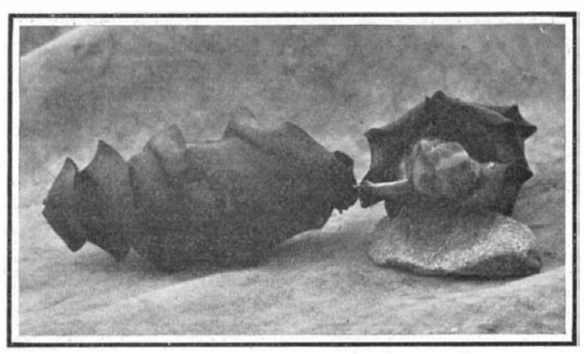
This remarkable construction is formed of eighteen parallel vaulted chambers of considerable length, which lie against each other and are separated by a dividing wall. They are built of masonry and covered with a very hard cement. The great size of the reservoirs may be judged from the fact that the total area covered by the water chambers is 440 feet in length and 125 feet in width, thus forming an oblong structure. Each of the chambers is about 100 feet long and 24 feet wide. The top of the reservoir lies just below the ground level, while the cement floor which forms the bottom is far below ground. Each chamber is covered with a semi-circular vaulting of masonry. From the floor to the top of the vault the height is some 30 feet. The water chambers are rounded off at the ends and they are separated by a strong wall which has a central opening so as to allow the rooms to connect with each other. Along each side of the main construction runs a long and narrow gallery which opens on to the ends of each basin. The floor of the gallery is 20 feet higher than the main floor. It is to be remarked that the two end basins and the middle one of the series have their ends occupied by round chambers in the form of large wells covered by a cupola at the top. These round wells are filled up and there seems to be no doubt that they were used as filters for the water before it passed into the main reservoirs. This fact was virtually proved at the time when the cisterns were restored for use a few years ago. During the work there were found a great number of conduits near the upper part and on all sides. These had been used to bring the water from different quarters into the cisterns. Further down, near the bottom, were seen another set of conduits which led the water off to various parts of the city. Our engraving shows the present appearance of the reservoirs. The main area is outlined by the stone wall which lies above ground, and we also observe the middle and end cupolas which top the filtering wells. The small, circular openings, of which each basin has three, lying flush with the ground, have been covered over with glass. In the background is the historic spot which the citadel of Carthage formerly occupied. It is now crowned by the Cathedral of St. Louis and the museum in which the Rev. P. Delattre is constantly placing new objects which come from the excavations. Another view shows the interior of one of the eighteen long chambers, which is nearly filled with water. The character of the vaulting and the openings in the roof will be noticed. The total volume of water which the whole reservoir contains is estimated at five million gallons.

Another set of great reservoirs is found at some distance from the preceding and nearer the top of the hill. These cisterns were no doubt as extensive as the first series, but they are now in a very dilapidated state and have nearly disappeared under the soil, which has gradually filled them up. When the Arab geographer, Edrisi, visited the spot in the eleventh century he was struck with admiration at the imposing form which they presented.



Swell Shark Photographed While Swimming.

At that time there were twenty-four reservoirs running parallel to each other, each one covered by a vaulting and measuring 330 feet long by 70 feet wide. At present the remains of only eighteen chambers are visible, and these are partially destroyed and filled up with alluvial earth which has sifted in during the ages. Our engraving shows a part of La Malga reservoirs in their present condition. The remains of an aqueduct which supplied the cisterns have been found to the northeast of the Arab village. The natives have found statuettes and other objects around the spot.



Spiral Egg of Port Jackson Shark.

Egg on the right shows the young shark protruding, or as it appears when about to escape.

AN INTERESTING SHARK.

BY CHARLES FREDERICK HOLDER.

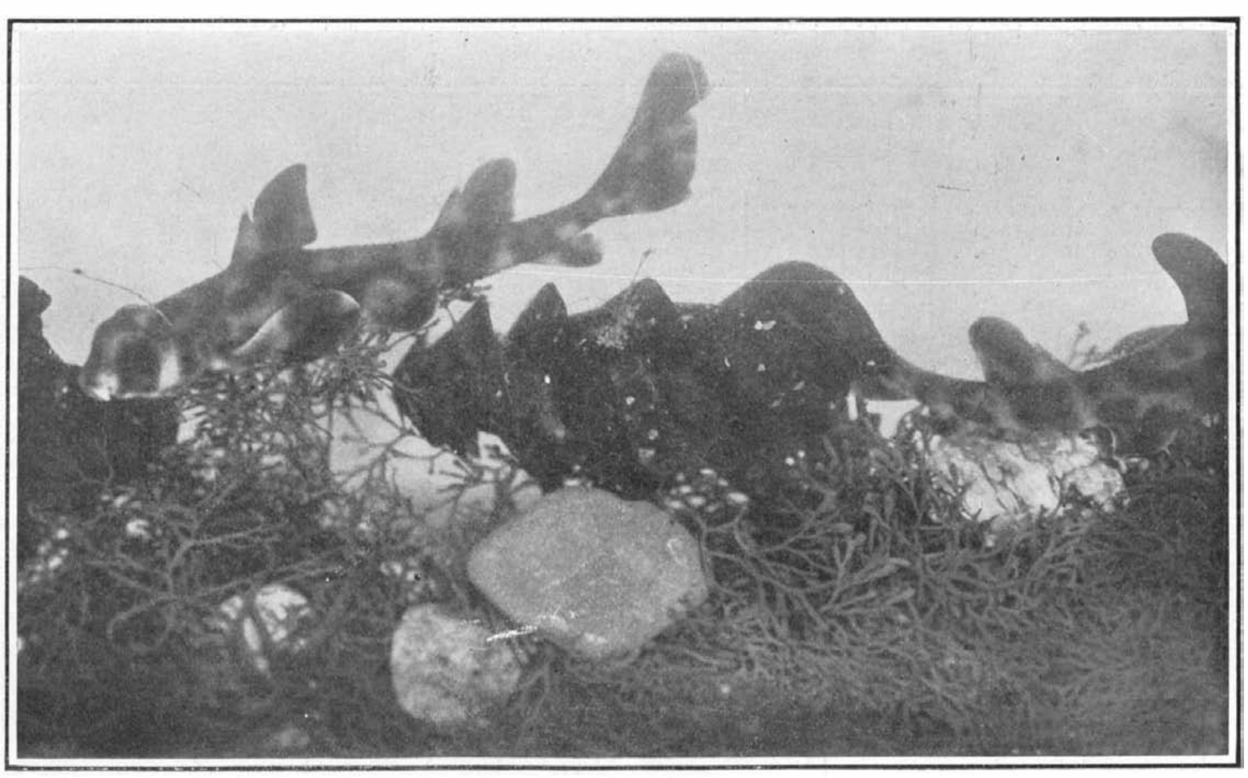
Up to within a few years the ctenoptychius shark was known only by its spines and bits of pavement-like teeth. From these geolcgists described it years ago, and supposed that like many other forms it had become extinct. As the various zoological expeditions were sent out by different governments one entered Port Jackson, New South Wales, and in dredging found a living Trigonia shell that was supposed to be extinct, as those known occurred only in the fossil secondary deposits in Europe. One of these expeditions found, with the Trigonia shells, spines almost identical with the fossil extinct Cestracionidæ; then a boatman told the zoologist that the fish itself was common there, and volunteered to produce specimens in any quantities.

The Cestraciont sharks are included in the family *Heterodontidæ*, and in the years following four species have been determined in the Pacific Ocean, *Gropleurodus Francisci* and *G. Quoyi* being the best known — the latter from the region of the Galapagos Islands, and the former from Southern California. The modern representatives of these sharks average about two feet in length. They are rendered conspicuous by two dorsal fins, each preceded by a large, powerful, and beautifully colored pink spine—a heritage of the ages. The body is long, tapering gracefully to the tail, which is large, broad, rising upward, with two notches. The shark appears to have a forehead, the head being blunt, and the peculiar nostrils are confluent with the mouth, which is small, narrow, and in the upper lip divided into seven curious lobes. The ridges above the eye are prominent, and the eyes are placed high in the head.

The most interesting feature of the shark is the egg, a somewhat conical-shaped spiral object four or five inches in length, and in form a perfect screw with wide flanges. Its color is a rich, dark mahogany, smooth and beautiful in texture. In the accompanying illustration a group of the young and eggs are shown, the shark being about two months old. The sharks shown were alive and the eggs unhatched. The photograph was taken by Charles Ironmonger under the writer's direction, and a difficult process, the dominating idea being to show the sharks alive but with a perfectly natural environment. The photograph represents a fairly perfect picture of the bottom, algæ, and rocks among which the writer has seen the sharks lying.

One might well wonder what object was attained in the production by Nature of such an egg. It is an almost perfect imitation, as regards color, of some of the weeds in which it is found; and it is very evident that the edges of the "screw" or spiral would prevent it from being washed ashore even in a heavy gale. So doubtless the peculiar shape may be a plan of resourceful Nature to afford protection to the egg, and that it is successful is evident as the shark has with some slight change survived the changes of ages.

I have often taken another shark in lobster pots with the Port Jackson variety, one that bears a close resemblance to it, especially in color and general shape. This is the swell shark, *Catulus uter*. It rarely exceeds two feet and a half in length, and has habits almost identical with the Port Jackson shark, lying in the hollows of the rocks, or hidden away in the dense masses of kelp found on this coast, possibly coming out only at night. Its color is gray below and with a burnt umber tint; the upper portions dark, with black and brown reddish spots, with here and there white patches. When kept in confinement, they lie on the bottom, never moving unless touched or forced from their position.



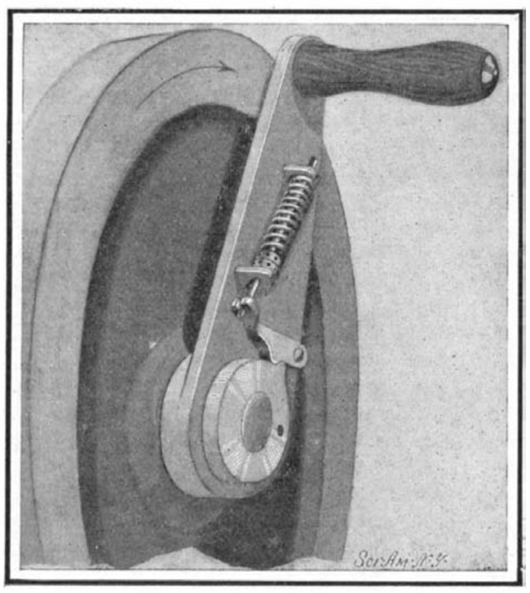
Port Jackson Shark and Spiral Eggs. Photo Charles Ironmonger.

A DESCENDANT OF A PREHISTORIC SHARK.

AN AUTOMOBILE SAFETY STARTING CRANK.

In starting automobile motors it sometimes happens, owing to too early explosions, that they will "kick back," as it is called, and wrench or break the arm or wrist of the operator.

The object of the safety starting crank shown in the illustration is to avoid this danger and shock by providing a yieldable connection between the crank and shaft, that becomes effective the instant rotation reverse to that of the starting direction occurs. This yieldable connection is obtained by simple means. The crank is held normally loose on the engine shaft between two disks. The outer disk contains within it the usual pawl common to all handles, to connect it with the shaft when the engine is turned over, as shown by the arrow. On the crank handle is a new supplementary device, intended to afford relief in case of sudden shock backward. This consists of a spring-actuated rod arranged on the face of the crank in the direction of its length, square shaped at its lower end, with nuts provided for adjusting the tension of the spring on the rod to any desired degree; the lower end of the rod, being flanged, presses against a pawl or dog



A NEW STARTING CRANK.

pivoted at one end and having on its lower side a projection which impinges against a cam projection on the edge of the outer disk.

In revolving the crank handle for starting, the pressure of the rod against the pawl brings the latter into contact with the outer disk projection and carries the shaft with it, but should a sudden impulse in the reverse direction occur, the cam on the pawl will ride up over the projection (on account of its shape), and allow the shaft to revolve freely in that direction. This in turn relieves the hand of the operator from shock. The tension of the spring on the rod may be readily adjusted to suit the friction and compression required to be overcome in starting different-sized motors.

Should the spring become damaged or break, the crank handle may be locked to the crank-disk portion by inserting a pin in the hole shown on the outer end and then be used as an ordinary crank handle.

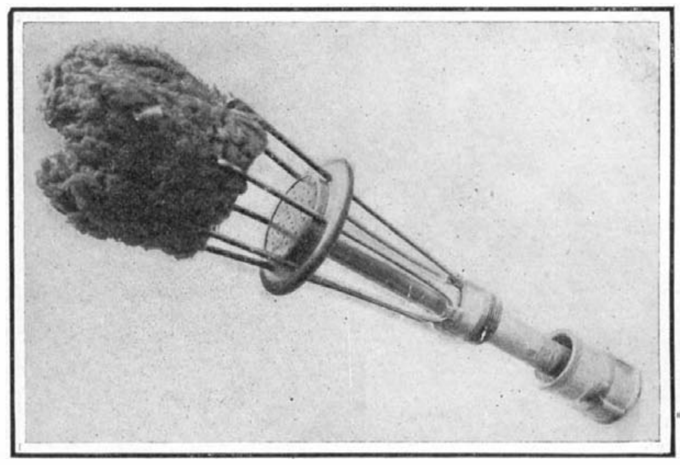
The illustration shows the mechanical parts on the outside of the crank face, for the sake of clearness. These can be neatly housed on the back, with an opening to adjust the spring, so as to give the crank a neat appearance and protect its parts from dust.

The utility of this device is self-evident to all automobilists, especially to those who are inexperienced, in that it affords a means of avoiding small, but sometimes painful, accidents.

It has recently been patented by Mr. W. H. Schoonmaker, 84 South Fullerton Avenue, Montclair, N. J.

A NOVEL CARRIAGE-WASHING APPARATUS.

The apparatus shown herewith is designed for the purpose of holding a sponge to be used in washing a carriage, window, or any other object. It consists of a spraying nozzle encircled by a band of soft rubber. This nozzle is mounted upon the end of a pipe which is adapted to connect to a hose pipe by means of an ordinary coupling. This pipe has mounted upon it a slidable threaded collar having on its upper edge three lugs. Wires bent in the shape of a letter V pass through the lugs and also through holes in the sprayer disk above. These wires are hooked on their upper ends so as to engage the sponge, as shown. By sliding the collar along the pipe to the right, the sponge-holding wires are made to approach more closely together and thus pinch the sponge tightly at the same time as they draw it against the spraying nozzle. A suitable threaded cap locks the collar and thus holds the wires and sponge in this position. The water squirting through the sponge keeps it clean and there is always fresh water throughout it. The apparatus can be mounted on a long handle for use in washing windows; or, if so desired, the sponge can be removed entirely and the apparatus used as a sprayer. The rubber band around the spraying nozzle protects any varnished surfaces that the sprayer may touch. This apparatus, as is apparent to all, will be found extremely useful in the household and stable. It is made by the "Ideal" Carriage Washer Company, 148 Lenox Street, Rochester, N. Y. Its inventor, Harrie B. Howell, received a patent for the apparatus about a month ago.



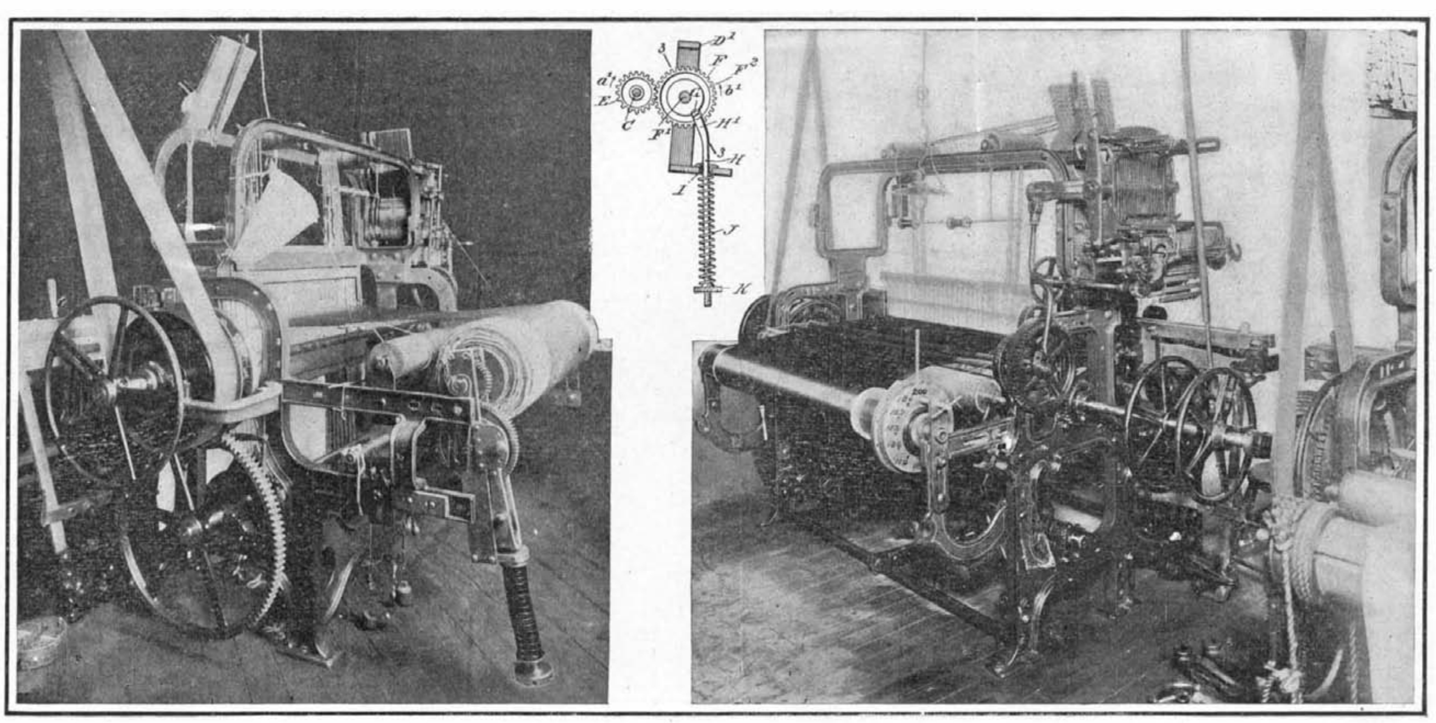
A NOVEL CARRIAGE WASHER.

NEW WARP-BEAM TENSION DEVICES FOR LOOMS.

The accompanying engravings illustrate two forms of a tension device for warp-beams of looms, invented by Mr. Gottlieb Keller, of 1480 Avenue A, New York city. These mechanisms have been attached to a number of looms and are, at the present time, in successful operation in every case where this has been done. A company has been formed to further these devices, and it has been predicted that they will be in general use before long. The company which will exploit the inventions is the Keller Machine Company, care of Hansen, Zinser & Power, 38 Park Row, New York city. Letters patent have been issued to Mr. Keller covering the form shown in the first half-tone, and in the line drawing, while the patent application to protect the other type has recently been allowed by the United States Patent Office. Foreign patents have been granted or have been applied for to cover both forms.

The object of the inventions is to provide new and improved tension devices for warp-beams of looms, arranged to give a uniform tension under varying weather conditions to insure the formation of faultless weaves. They do away with the massive and cumbersome weights—up to 800 pounds—hitherto utilized to give the necessary tension to the warp-threads by means of ropes wound around the ends of the warp-beams. These weights have really been an anachronism in the highly perfected and efficient loom of to-day, and it is really remarkable that some successful device to take their place has not been before designed. The warp unwinds from the warp-beam, having its shaft, *C*, journaled in suitable bearings on the loom frame, and on one or on each end of the said shaft is secured a pinion, *E*, shown in the line drawing, in mesh with a gear wheel, *F*, having its shaft, *F'*, journaled in suitable bearings formed in a bracket, *D'*, attached to the loom frame. On one or both faces of the gear wheel, *F*, are formed annular shoulders, F^2, on which bear projections, *G*, held in the members of a fork, *H'*, formed on one end of a tension or pressure rod, *H*, extending loosely through a bearing, *I*, held on the bracket, *D'*. A spring, *J*, is coiled on the tension rod, *H*, and abuts with one end against the bearing, *I*, and the other end of the spring rests on a nut, *K*, screwing on the threaded terminal of the tension rod, *H*, to allow the operator to increase or diminish the tension of the spring, *J*, by screwing the nut, *K*, up or down on the threaded end of the tension rod. When the warp unwinds, and the warp-beam turns in the direction of the arrow, *a'*, then the pinion, *E*, imparts a rotary motion to the gear wheel, *F*, in the direction of arrow, *b'*, where the projections, *G*, abutting against the shoulders, F^2, are carried along, thus exerting an upward pull on the tension rod, *H*, to compress the spring, *J*, thereof. Now, in case the warp, *A*, becomes slack, then the tension rod, *H*, on account of being under the tension of its spring, *J*, causes a turning of the gear wheel, *F*, in the inverse direction of the arrow, *b'*, so that the pinion, *E*, and the warp-beam are turned in a reverse direction to rewind the warp on the said beam. By adjusting the nut, *K*, as described, the spring, *J*, can be set to any desired tension according to the nature of the warp under treatment. By this arrangement, described above, the unreliable weights heretofore used for giving the desired tension to the warp, are entirely dispensed with, and it takes but a very short time on the part of the operator to set the tension rod, *H*, to the desired tension to secure a proper taking up of the warp on the beam in case the warp slacks under varying weather conditions or other causes. The bearing, *I*, for the rod, *H*, is arranged to allow the rod to readily slide in the bearing, and also to freely swing thereon so as to compensate for the travel of the projection, *G*, in the segmental path. In the photograph of this apparatus is shown an additional device wherein by means of an adjustable pin, the return travel of the gear wheel, *F*, to rewind the warp is regulated to from 1 to 6 inches. If this is not sufficient, the gears may be thrown out of mesh by sliding the pinion, *E*, laterally on its shaft, and the warp then rewound as far as desired.

The second device is even more compact than the one described above. It consists substantially of a flat wheel or disk having a depression within which is retained a coiled spiral spring. The shaft of the warp-beam extends through the hub of this wheel, and to this hub one end of the said spring is fastened. On the outside of the disk, means are provided for putting the spring under any desired tension and for retaining the same at that tension. The outer rim of the disk is graduated into

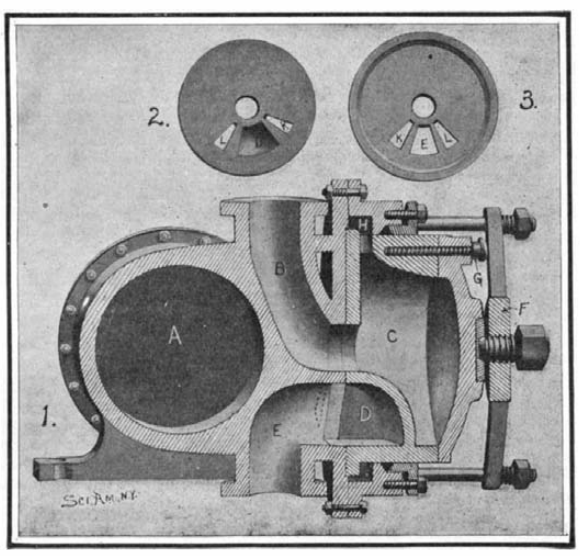


THE TWO KELLER TENSION DEVICES FOR THE WARP BEAMS OF LOOMS, IN OPERATION.

a scale which shows the exact tension of the warp threads due to the coiled spring. By means of this scale the weave may be closely regulated. A flat disk provided with ratchet teeth is suitably secured to the end of the warp-beam and covers the opening in the other disk containing the coiled spring, to one end of which is secured a pin carried by the closing disk. The disk containing the spiral spring carries a pawl which engages with the ratchet teeth to limit the return travel in rewinding. Should a greater return travel be desired, it is merely necessary to lift the pawl. The coiled spring maintains an even and steady tension on the warp threads, which is absolutely independent of meteorological conditions, an immense advantage over the old rope and weight system.

NEW ROTARY VALVE FOR STEAM ENGINES.

A new rotary valve for steam engines has recently been invented, which is designed to relieve the valve seat of boiler pressure, and to keep the balance of the valve without regard to the pressure in the boiler. The manner in which this result is obtained will be readily comprehended by reference to the accompanying engraving, which illustrates a section through a steam engine equipped with the improved valve. The cylinder is shown at *A*, and *B* is the port admitting steam from the boiler into the combined valve and steam chest, *C*. The bottom of the steam chest or valve, as illustrated in Fig. 2, is formed with a central opening communicating with the steam supply port, *B*, and is also provided with two radial openings, *K* and *L*, between which is a cut-away port, *D*. The valve seat, which is shown in Fig. 3, is similarly formed with radial ports, the port, *K*, communicating with one end of the cylinder, and port, *L*, with the other, while between them is the exhaust port, *E*. The bottom of the valve is formed with a flange which projects into



NEW ROTARY VALVE FOR STEAM ENGINES.

an annular balancing chamber, *H*, formed by a cylindrical casing bolted to the valve seat. Communication between the interior of the valve and this chamber is had through the port shown. A steam-tight joint is made between this casing and the valve. The valve is mounted to rock in the casing and is held under pressure by a screw in the spring-pressed spider, *F*. The link which connects the valve with the rocker is shown at *G*. In operation the cut-away port, *D*, alternately connects the ports *K* and *L* with the exhaust port, *E*. The flange at the bottom of the valve extends into the balancing chamber to an extent sufficient to balance the excess of outward pressure due to the ports cut in the bottom of the valve, so that the valve is held down properly on its seat. It will be understood, of course, that the valve seat must be fitted to a ground joint in order to secure the desired action and that if the area of the flange be equal to the area of the ported openings a perfect balance will be secured at all times. Mr. John Cruikshank, of Yorktown, Virginia, is the inventor of this improved rotary valve.

A STRIKING ILLUSION APPARATUS.

The field of inventions pertaining to stage effects and illusions is continually on the increase. We illustrate one of the latest, recently patented by Mr. R. B. Smith, Sydney, New South Wales, Australia, which possesses points of peculiar interest and novelty.

The illusion consists in showing a floating automobile about four feet above the stage, in motion, apparently traveling in the air with its occupant, going across the space of the stage, turning around and returning, then taking a flight upward in the air, until it is completely upside down, with the chauffeur there operating in the same way as in the beginning, and returning again to the stage. Our illustration gives an idea of the effect, showing the machine in two positions. It is necessary that the chauffeur be securely held in the machine to prevent him from dropping to the floor when in the reverse position.

Simple mechanism operated from behind the scenes is employed for producing this startling effect, and combined with peculiarities of lighting easily deceives the eye of the spectator.

Motion to the wheels is imparted by silent electrical

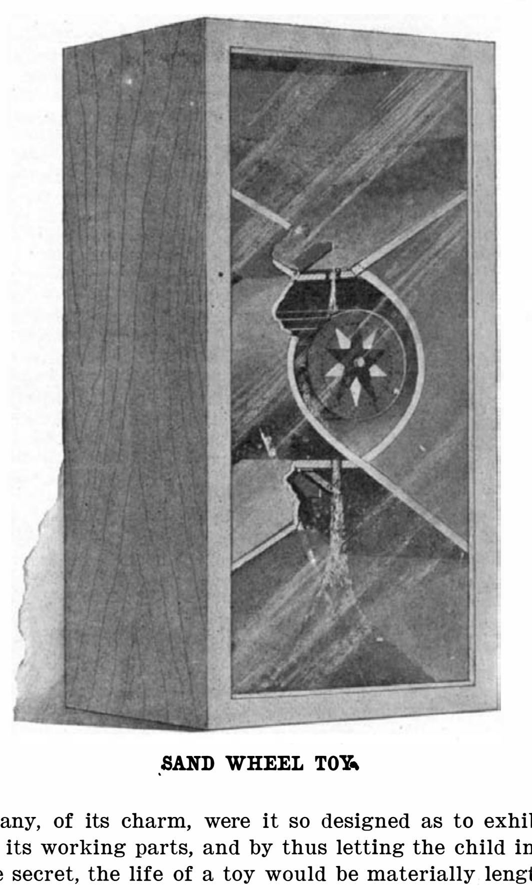
A STRIKING ILLUSION APPARATUS.

means. It is presumable that other devices can be utilized to imitate the noises observable in gasoline-driven machines in order to make the effect more realistic.

In the beginning, as the curtain rises, the automobile is observed floating in the air. The chauffeur, a lady perchance, walks in upon the stage and apparently steps through space as she gets into the machine. To show that it really is in the air, the magician passes a wand all around under the machine. The chauffeur starts the wheels rotating by a lever, and the illusion is continued. At its termination, the chauffeur steps out on what appears to be air and walks off from the stage, leaving the audience mystified as to how this effect was obtained.

SAND WHEEL TOY.

The use of sand falling on a wheel provides an excellent motive power for operating small toys of various descriptions. However, this form of toy is usually so constructed that the movement of the sand cannot be seen and the natural curiosity of the child is aroused to such an extent by the mysterious power within the toy that he is very liable to destroy the toy in order to discover the secret of its action. It has occurred to Mr. Harvey I. Dedrick, 26 South Center Street, Schenectady, New York, that the toy would lose little,

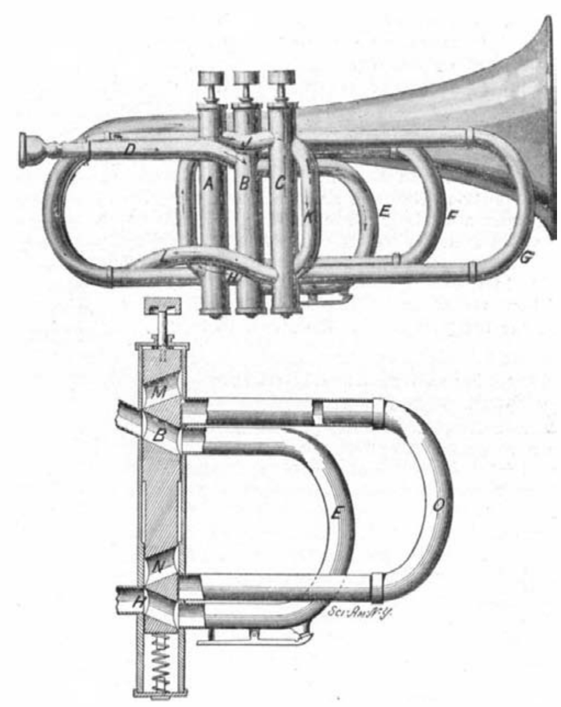


SAND WHEEL TOY.

if any, of its charm, were it so designed as to exhibit all its working parts, and by thus letting the child into the secret, the life of a toy would be materially lengthened. Aside from this feature Mr. Dedrick has designed an improved valve which will prevent the wheel from becoming clogged with sand and has also provided means for keeping the sand out of the bearings of the wheel. In the accompanying engraving the general design of the improved toy and the construction of the sand valves are clearly illustrated. The box containing the mechanism is provided with a glass cover so that the flow of sand can be observed. Sand hoppers are provided at opposite ends of the box, after the fashion of an hour glass. Between the hoppers is a chamber, in which a sand wheel is mounted. The sand flows through an opening in the bottom of the upper hopper, onto the vanes of the sand wheel, rotating it like an overshot mill wheel. Thence the sand flows out through an opening into the lower hopper. When the upper hopper is emptied, the toy may be reversed so as to continue the flow of sand and the rotation of the wheel. To prevent the wheel chamber from becoming choked with sand, it is desirable that the sand should flow out more rapidly than it can enter. To this end each hopper is provided with a hinged valve covering its opening into the sand wheel chamber. The valves are operated by gravity, so that no matter which end of the toy is up the valve of the upper hopper will fall to closed position, while the lower one will swing open against a stop. Sand then flows into the wheel chamber, through a small perforation in the upper valve, but flows out into the lower hopper through an unobstructed port.

A NEW WIND INSTRUMENT.

Letters patent have recently been granted to Mr. Harman J. Ellis, of Brooklyn, Wis., covering an improved form of musical instrument. The invention, illustrated in the accompanying engraving, relates to wind instruments such as cornets, horns, and the like, and provides means for readily lowering or raising the tone by the manipulation of corresponding valves, the ar-



A NEW TYPE OF WIND INSTRUMENT.

rangement being such that the formation of abrupt bends for the air passages is completely avoided to insure a rapid and unobstructed flow of the air. The complete view of the illustration shows the invention in the form of a cornet, while the detailed view shows the cross section of one of the valves. As shown in the side elevation of the entire instrument, it is provided with three valves, *A*, *B*, and *C*, arranged one alongside the other and each having a spring-pressed piston adapted to be manipulated by the player, and two sets of ports. The valve, *B*, is connected at its forward side with a mouthpiece-tube, *D*, carrying the usual mouthpiece, and when the several valves are in their normal non-pressed positions, the air forced through the mouthpiece and the tube, *D*, passes by way of a port into a U-shaped or return-bend tube, *F*, connected with the valve, *B*, at a port which joins with a short connecting tube, *H*, leading to the valve, *A*, at a port which connects by a tube with another port of *A*. This is connected by a short tube, *J*, with a port of *C*, connected by a tube, *K*, with another port of *C*, which in turn is connected by a tube, *L*, with the bell of the instrument. From the foregoing it will be seen that each of the valves, *A*, *B*, and *C*, has a return or U-shaped tube connected at both ends to the corresponding valve-casing at or near the upper and lower ends thereof, and each tube normally registers with a set of ports in the corresponding valve. When a valve is pressed, the shorter tube is cut out and the longer tube is brought into action to provide a correspondingly longer air passage and a consequent change of tone. When it is desired to lower the open tone one-half an interval, it is necessary to press the piston-valve of the valve, *B*. When it is desired to lower the open tone one full interval, the piston-valve of the valve, *A*, is pressed, and when the valve *C* is operated the tone is lowered an interval and a half.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

POCKET ELECTRIC BURGLAR-ALARM.—H. A. Kreh, New Orleans, La. This invention relates to electric alarm mechanisms and admits of general use, but is of peculiar value in preventing burglaries and theft. It may be used to advantage by travelers, theatrical performers, and persons whose jewels, goods, and chattels are peculiarly liable to be stolen. Also in all instances where it is desired to apprise a person of the opening of a door, window, or other closure member of any kind.

Of Interest to Farmers.

GATE.—T. J. Van Pelt, State Center, Iowa. This improvement is in farm-gates of the vertically-swinging type adapted to be opened or closed from either side of the gateway by a person in a vehicle, the object being to provide a gate of this character that will be practically automatic in operation, simple in construction, and having no parts liable to get out of order, broken, or interfered with by snow or ice.

Of General Interest.

APPARATUS FOR HAND-WEAVING.—Mary E. Bartlett, Baltimore, Md. This is an apparatus to be employed by children in kindergarten and primary schools for weaving diminutive tubular garments, particularly caps, dresses, and stockings for dolls. The invention is embodied in construction and form of the pattern-card or handloom proper upon which the weaving is done and by which the definite and required shape of the article of apparel is imparted, and also in the manner in which the weaving and detachment and subsequent tying-in of the garment are effected.

ANIMAL-BLANKET.—C. H. Carli, Stillwater, Minn. This improvement is particularly in blankets for horses, the object being to provide a simple means for preventing the blanket from slipping around on the animal when used as either a night or street covering. Simple devices secure the front of the blanket over a horse's chest and obviate the employment of the usual straps or buckles.

ATTACHMENT FOR PHONOGRAPHS.—L. T. Prudon, North Bergen, N. J. In this case the invention relates to an attachment for phonographs and similar instruments, the attachment being in the nature of a gage for stopping the carriage of a phonograph at any desired point in order to make repetitions of a record without repeating portions of the record which precede the part that it is desired to repeat.

Heating and Lighting.

SMOKE-CONSUMER.—A. Grönberg, Wasa, Finland, Russia. This improvement relates to an arrangement to effect the burning of smoke and saving of fuel and can be applied to boilers of any construction. Applied to furnaces for steamers of modern construction with retrogressing tubes, the idea does not in this case necessitate alteration, the heated air being introduced through the fire-bridge, where the smoke is ignited and smokeless gases pass through the tubes. When boilers with exterior surfaces or tube-boilers are employed, a special stove must be erected before the boilers into which grates, tubes, etc., have to be placed and the firing is done, the heated air being introduced at a place that allows the smoke to be ignited before the gases touch the fire-surface of the boiler.

ACETYLENE-GAS GENERATOR.—E. M. McGee, Yankton, S. D. In this patent the invention relates to certain improvements in acetylene-gas generators providing for a reliable automatic carbid-supply and insuring automatically closing the various valves in communication when the carbid-chamber is open to replenish the charge.

AIR-HEATING DRUM.—G. E. Leonard, Sheridan, Wis. The object of the present invention is to provide a new and improved air-heating drum for stoves arranged to support the tubular heating-drum on a comparatively cool surface by causing a rapid circulation of air through the heating-drum and providing the top thereof with an asbestos filling. It relates to heating-stoves having a tubular heating-drum, such, for instance, as shown and described in a former patent granted to Mr. Leonard.

Household Utilities.

SHADE-FIXTURE.—F. G. Rohner, Dubuque, Iowa. In rented houses every tenant ordinarily secures new sets of shade and curtain fixtures, and after a few changes the window-casings become greatly disfigured. The chief object of the invention is to provide permanent fixtures which can be adjusted to support any shade likely to be used. To accomplish this result, the inventor provides a plate to be adjustably secured to the casing or the like and a bracket adapted to be supported by the plate and in turn adapted to support the shade.

Machines and Mechanical Devices.

PARALLEL MOTION.—F. M. Myers, Carthage, Mo. The object of this invention is to provide means for sustaining a moving member so that the member will be given an extensive movement laterally simultaneously with and in addition to its movement longitudinally. The invention may be employed in numerous connections, an obvious application being to stone-forming machines, where saws may be engaged with the stones four times for each revolution of the crank-shaft.

OIL-FLOWING DEVICE.—J. Kambish, Jr., Piney, W. Va. In this patent the invention relates to apparatus for raising oil, water, or other liquids in wells by the use of a gaseous fluid under pressure. The object is to provide a new and improved oil-flowing device arranged to utilize the gas frequently found above the oil strata for flowing the oil to the surface and for collecting and saving the said gas.

APPARATUS FOR PURIFYING WATER.—H. F. Hodges, Philadelphia, Pa. The invention has reference to an improved apparatus for the purification of water, and has for its primary object to provide means for removing from water any bacteria, gases, or other impurities which it may contain, whether of a solid or liquid nature, by the agency of heat.

METHOD OF PURIFYING WATER.—H. F. Hodges and J. Kuen, Philadelphia, Pa. In this case the invention has relation to an improved method of purifying water, primarily by distillation, whereby the water is entirely relieved of all impurities, whether of a solid, liquid, or gaseous nature. The process gives to water its natural sweet taste, and renders it more palatable for table use.

WATER-STILL.—H. F. Hodges and J. Kuen, Philadelphia, Pa. The principal object of the invention, which relates to an improved construction of apparatus for the distillation and purification of water, is to provide an apparatus so constructed as to enable the inventors to utilize a primary body of heat to evaporate and purify successive bodies of water in such a manner that the consumption of fuel for this purpose is greatly decreased and the cost of production consequently minimized. The distillate is improved in taste by the process, and its effect upon the human system is rendered as beneficial as is possible by the use of the purest spring-water.

APPARATUS FOR PURIFYING WATER BY DISTILLATION.—H. F. Hodges and J. Kuen, Philadelphia, Pa. Among the objects of this invention the principal one is the provision of means for distilling and purifying water whereby it is entirely relieved from all impurities either of a solid, liquid, or gaseous nature, and at the same time relieved of that flat or bitter taste ordinarily found in distilled waters, and becomes possessed of properties and qualities rendering it sweet and palatable. The means provided materially increase the number of working cells in the apparatus without proportionately increasing the amount of fuel used.

CEMENT-BLOCK PRESS.—E. H. Harry and I. L. Shaw, Gibson City, Ill. The employment of cement blocks as a foundation material for construction of foundations and walls of buildings has greatly increased of late and their superiority for this purpose has led to many inventions in means for producing them. The present invention has for its object to provide an improved press which shall be distinguished by lightness, strength, rigidity, ease of operation, and economy of construction.

Prime Movers and Their Accessories.

ROTARY ENGINE.—I. F. Parmenter, Berlin, Mass. This invention is designed more particularly as an improvement on an engine previously patented by Mr. Parmenter. The present improvements are designed to provide for a better control of the steam or other motive agent by providing improved means for governing the distribution of the steam so that the operation of the engine may be regulated with greater decision.

ENGINE.—R. P. Moodie, Renfrew, Ontario, Canada. According to the embodiment of the invention the engine is arranged to have the motive force act against one face of the piston in the usual manner. At the opposite end of cylinder, however, the rod is passed through a stuffing-box or its equivalent, and this end is employed at times as a compressor, at other times as a power-cylinder to start the engine, these operations being controlled by a valve. In this manner the engine when running may be made to compress air or other elastic fluid, which may be stored and employed to start the engine upon a further operation.

WIND-WHEEL.—O. Ulrich, Gross Lichterfelde, near Berlin, Germany. The object in this invention is to provide a new and improved wind-wheel in which the wings adjust themselves automatically, according to the wind-pressure, to insure a steady uniform running of the wind-wheel both in light and strong winds and requiring no mechanical regulating devices for setting the wings to the proper angle.

Railways and Their Accessories.

RAIL-FASTENER.—H. M. Mace, Catskill, N. Y. The object of this inventor is to provide a fastening device to be used in connection with railway-rails for the purpose of holding them firmly to their ties, which device will prevent the rails from spreading and tilting and will also reduce to a minimum their tendency to creep.

Pertaining to Vehicles.

ATTACHMENT FOR VEHICLE-SHAFTS.—D. J. Quigley, Litchfield, Minn. This invention refers to means for connecting thills or shafts of vehicles with their running-gears so that the shafts may be shifted laterally to permit the animal drawing the vehicle to travel at one side of the center of a country road out of the rut and on firm ground, while the wheels run on the beaten track. The object is to afford means for adjustably counteracting side draft and permitting the shafts to be shifted toward or from the center of the axle without the use of tools.

Designs.

DESIGN FOR LACE TRIMMING.—C. G. Neubarth, New York, N. Y. Mr. Neubarth has invented a new, original and ornamental design for a lace trimming, in which the elongated scalloped ornamentation runs from edge to edge of the band of linen, silk, or the like, over bars crossing each other at right angles.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

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Inquiry No. 7276.—For manufacturers of baby carriage wheels and velocipede wheels for cushion tires.

Inquiry No. 7277.—For parties to make tanks used for hand fire extinguishers.

Inquiry No. 7278.—Wanted, elevator buckets with sprockets and chain for attaching bucket.

Inquiry No. 7279.—For makers of solid back horse brushes, with a "Turtle" as a trade mark.

Inquiry No. 7280.—For makers of carpet-cleaning machines.

Inquiry No. 7281.—For machinery for making chewing gum.

Inquiry No. 7282.—For the makers of an extract having taste and flavor extracted from muskmelon.

Inquiry No. 7283.—For makers of baby carriage and go-cart wheels.

Inquiry No. 7284.—For makers of watchmakers' materials.

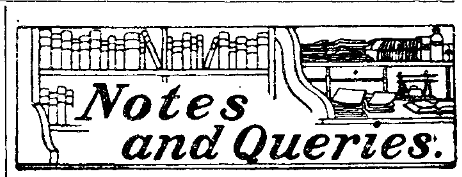
Inquiry No. 7285.—For makers of prepared solder, as can be used for household use without an iron.

Inquiry No. 7286.—For the manufacturers of alcohol gas stoves, Excerpta coffee pots and Patent Hydronette and Water Bringers.

Inquiry No. 7287.—For the makers of the "In and Out" registers for hospitals.

Inquiry No. 7288.—For manufacturers of laundry supplies and washing machines

Inquiry No. 7289.—For manufacturers of elastic rubber, double-valved exhaust, ellipsoid shape, for creating a vacuum in a bottle or other vessel.



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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(9776) W. B. asks: Would like to know the materials needed, and how to develop blue prints. Or is there a book published that would teach me same, without going to any school? A. Very little skill is required to make blue prints. Take citrate of iron and ammonia 80 grains and water 1 ounce, for one solution. Take ferricyanide of potassium 60 grains and water 1 ounce for a second solution. Mix the two in equal parts when you wish to make the paper. With a swab of absorbent cotton cover the paper evenly and dry in the dark. Keep in a dry and dark place. Print as for any photograph, but stronger, till the shadows are bronzed, and place the print in a pan of water to develop. Wash in changes of water till all the color is out of the white parts of the print.

(9777) C. P. L. asks: Would two bodies exactly the same shape and size but differing greatly in their respective weights (say for instance, one was composed of iron and the other of wood) reach the ground at the same time, if dropped simultaneously from a great height? A. The heavier of two bodies of the same size falls faster, since it has more momentum with which to overcome the resistance of the air when dropped from a height.

(9778) F. W. B. asks: 1. Please give (in substance) an explanation of the phenomena of rotating storms, such as whirlwinds, cyclones, etc. Do they always rotate in one direction, and why? A. The rotation of storms is caused by the rotation of the earth on its axis. In the northern hemisphere these storms rotate in a direction opposite to the motion of the hands of a clock; in the southern hemisphere they turn with the hands of a clock. All cyclones, hurricanes, tornadoes, etc., follow the same law. 2. Is it possible for a whirlwind to rotate for a time in one direction, and then reverse and whirl in the opposite? I ask this last especially for the reason that two reputable persons of my acquaintance claim to have seen this phenomenon. A. Small whirlwinds, such as form in a field or at a street corner, probably turn in either direction; but if one was seen to rotate one way, and in a brief time another was seen in the same place turning in the opposite direction, we should consider that these were two different whirlwinds, and not a whirlwind which had reversed itself.

(9779) L. A. H. asks: Is there such a thing in the realm of science as flame or combustion without emitting light? A. Combustion is usually the combination of a substance with oxygen. This may take place with rapidity, so that much heat is produced, and also light; but often it takes place so slowly that no light is seen, and the temperature may not rise very much above that of the air. The rusting of iron or steel is an example of this.

(9780) J. M. asks: 1. If all so-called empty space is absolutely cold and dark, and light and heat on the earth are only the result of the sun's rays agitating the particles of matter contained in the earth's atmosphere, how then can the sun illuminate the moon to such an extent that the reflected light reaches the earth?—bearing in mind that the moon has no atmosphere. And by what explanation can Prof. Newcomb's views be understood? It would seem to my lay mind that the moon is always cold and dark, it having no atmosphere to cause the sun's rays to heat or light it; but how does its light reach the earth? A. The present accepted theory is that light is not light on its way through space, but radiant energy, which becomes light or heat upon striking some material object which can transform it into light or heat. There is then no light in the space between the sun and the earth, but if an eye were to be placed there, it would receive the energy of the sun's rays and see that energy as light. If a hand or a thermometer were placed there, the radiant energy would be transformed into heat, and would affect the hand or thermometer. This radiant energy strikes the surface of the moon, and is reflected to the earth. Here we receive it, and see it or feel it as light or heat. The space is dark and cold. The material is warmed by the sun's radiation. Space contains little which can be warmed. The moon will be warmed when the sun's rays strike it, and will become cold again when the sun sets as the earth does. The changes will be more rapid and extreme be-

cause of the absence of a dense atmosphere such as the earth has, but not less real for that reason. 2. Is space limitless? It cannot be conceived it has limits, as the mind would inquire what is beyond. Yet every object occupies a fraction of space, and as a fraction is only conceivable in reference to a whole, it would seem that there is a limit; what is the philosophical explanation? A. As to space we know little, and speculation can teach nothing. To a scientific mind it seems fruitless to discuss what can never be settled by discussion. Astronomers now believe there is an end to the worlds in space; but belief is not knowledge. We may know some time, but not till we go beyond the flesh and sense.

(9781) M. O. C. asks: Please give me the difference between a whip-poor-will and the bull-bat; the zoological and common name of each bird, and to what genus each belongs? And if the bull-bat is the same bird as the nighthawk? Also give the distinction between a catamount and a wild-cat. Which, if either, has the long tail? A. The bull-bat and the nighthawk are different common names for the same bird. The scientific name of the bird is *Chordeiles Virginianec*. The scientific name of the whip-poor-will is *Antrostomus vociferus*. The genus of anything is indicated by the first word of its scientific name; the species, by the second word of its name. A catamount is another name for the cougar or mountain lion. A wild-cat is a lynx. It has a short tail, and most of the species have a tuft of hair on the tip of the ear.

(9782) M. F. S. says: 1. Would you kindly explain the real meaning of the word "watt"? One says that a 16-candle-power lamp takes 56 watts, say 60 watts for convenience, per hour. If it takes 60 watts per hour, it should take 1 watt to light it for 1 minute. Yet we all know that it takes the full 60 watts to light it even for one second. A 300-watt dynamo does not give 300 watts per hour, it gives them all the time; if such a dynamo were connected with a watt-meter, would the watt-meter register 300 watts after an hour? A. A watt has no reference to time. It is the unit of electric power. And just as a horse-power works right along, a second, an hour, or any other time and is the same horse-power, so the watt is the same for any time. If a lamp requires 60 watts to light it, it will require the 60 watts for a second just as really as for a whole day. What is paid for on the watt-meter is the watt-hours. If 1,000 watts are used for one hour, that is a kilowatt-hour; and if for ten hours, the consumer must pay for ten kilowatt-hours. This too is just the same as the horse doing work. If one hires a horse which might do a horse-power of work, he will pay for the same horse working for the entire time which he does work. The idea seems simple. 2. Does the sun have any direct influence upon the weight of objects on the earth? Example: Will an object be theoretically heavier at midnight than at midday? A. The weight of objects does not vary from noon to midnight because of the position with reference to the sun. The change of distance from the sun in that time is so small as compared with the immense distance of the sun as to be of no value at all.

(9783) J. S. asks: 1. How does the last part of our names originate? A. The surname, or family name as it is at present, is a name added to and above (*sur*) the individual name. These often denoted the occupation of the man at the time the name was taken. An example is John Smith, or John the "smith." When the peasantry had but a single name, it was well nigh impossible for the officers of the law, or the crown, to locate the man wanted, as one can easily see by considering the case at present. It is far easier to locate a particular John Smith even than a particular John. There are many more Johns than there are John Smiths. Under these circumstances the authorities compelled the adoption of a second name, which was often arbitrarily given, and so we have names of birds, places, colors, and many others as family names. 2. Is it air buoyance that causes the stocks of wheat to be stronger against the wind than if the stocks were solid? A. There is a very common misapprehension regarding a hollow shaft, such as a grain stalk, or a bone, quill, or other tube. A stalk of wheat or a bone is not as strong as if it were of the same *size* and *solid*. It is stronger than if it were of the same *weight* and *solid*. In other words, a given amount of material can be made into a stronger shaft by giving it the form of a hollow cylinder than to make it a solid rod of any shape. It is the stiffness and elasticity of a grain stalk which enable it to stand up against the wind. 3. Can a body be charged purely positively or negatively? Must there not be a little negative electricity in a body that is supposed to be charged positively, and *vice versa*? A. A body is charged positively by giving it an excess of positive electricity. Only as much negative electricity is removed as there is positive electricity communicated to the body. If more positive electricity should be given to the body, more negative electricity would be removed. 4. Why is the negative pole of a medical battery stronger than the positive? That is, stronger to the feelings. A. We were not aware that the negative pole is stronger than the positive pole, to the feelings even, and can give no reason for it. 5. I notice water is a better conductor when hot than it is when cold. Can you give a reason? A. We have never measured the resistance of water at various temperatures, and cannot give any reason why hot water should have less resistance than cold water. 6. Can you give a scientific explanation of the famous painting entitled "In the Shadow of the Cross," painted by Henry Hammond Ahl, which was exhibited at the world's fair, St. Louis? This religious painting is of the Master, and when the room is darkened, the painting appears luminous, which makes the appearance of a pale moonlight. A cross can be seen lying over his shoulders, which is not observable when the room is lighted. A. The painting to which you refer was painted with a phosphorescent paint which glowed in the dark, but did not appear in the light. 7. In going up in an elevator do we not weigh heavier and in coming down weigh lighter? A. A person is no heavier while going up in an elevator than while coming down. If the elevator starts up suddenly, the inertia of the man would cause him to exert a greater pressure on the floor than his weight; and if it was jerked down quick enough it might even leave the man in the air, not pressing at all on the floor of the car. You can hold an apple on your hand, and drop your hand away from it so quickly as to leave the apple in the air above the hand.

NEW BOOKS, ETC.

Ordinary Foundations, Including the Cofferdam Process for Piers. By Charles Evan Fowler, C.E. New York: John Wiley & Sons, 1905. 8vo.; pp. 214. Price, $3.50.

This book, which has reached its second edition, has received numerous valuable additions. The subject of ordinary foundations is more comprehensively covered than heretofore and several new chapters have been added, one of the most important of which discusses the construction of piers by the use of metal cylinders; with timber caissons by open dredging; and the construction of ordinary-sized foundations by the use of pneumatic caissons. Another new chapter is that on cement and concrete, which contains many valuable tables giving the amount of material required for concrete of different proportions. Other chapters which were not in the first edition are one on the subject of foundations, in which the bearing capacity of soil is discussed, and another on building stone, masonry, and the design of piers. The building of piers of timber and pile bents, together with the subject of timber preservation, has been discussed in the final chapters as fully as a general knowledge requires. The book is illustrated with some 150 cuts, many of which are fine half-tone plates.

The Compound Engine. By W. J. Tennant, A.M.I.Mech.E. London: Percival Marshall & Co., 1905. 8vo.; pp. 200. Price, $1.

This is a popular treatise intended as an introductory manual to the study of the compound engine. The first seven chapters give a great deal of information such as is desired by the ordinary person who has very little knowledge of the subject. The eighth chapter deals with the graphic method of indicator diagrams for a two- or three-stage compound of the ordinary, or receiver, type. In succeeding chapters the indicator diagram cylinder ratios and the action of the receiver are dealt with more minutely than in the opening chapters, and the subjects of jacketing, the condenser, and the air-pump are touched upon. The book has three appendices, consisting of Prof. Unwin's paper on "The Construction of Theoretical Indicator Diagrams for Compound Engines," part of a paper on "Expansion Curves," by the author, and tables giving the dimensions of typical compound engines, of the marine, stationary, and locomotive types.

Mechanical Drawing: Technique and Working Methods for Technical Students. By Charles L. Adams. Boston: George H. Ellis & Co., 1905. 4to.; pp. 204.

The training of the senses so as to give facility and precision in the technique of drawing, and the acquirement of technical methods of execution, are necessary preparatory requirements for a course in engineering or architecture. These are what the author of the present work had in mind when preparing it. The book has a collection of material sufficient to enable the teacher, by judicious selection, to lay out the work of the course, and it is further specialized to meet the needs of individual students. The subject of projection has been omitted, as the author believes that when a course includes descriptive geometry, it is unnecessary to give a portion of this subject under a different name. The book not only goes thoroughly into the technique of drawing and the instruments required, but it also describes pseudo-pictorial representation, wash drawing, and mechanical copying, such as the blue-print process, process drawing, and Patent Office drawing. It is abundantly illustrated with over 160 drawings and plates.

Proceedings of the Society for the Promotion of Engineering Education. New York: Engineering News Publishing Company, 1905. 8vo.; pp. 253. Price, $2.50.

This book is the twelfth volume of the "Proceedings of the Society for the Promotion of Engineering Education." It contains some fifteen addresses on engineering education by well-known engineers in its various phases, and also memoirs of the following deceased members of the fraternity: Benjamin Franklin LaRue, Thomas Messinger Drown, Robert Henry Thurston, and Burton S. Lanphear. A suitable index is added to the book, which also contains the names and addresses of all of the members.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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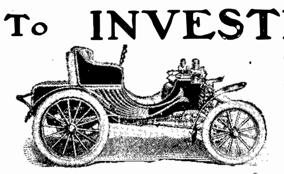

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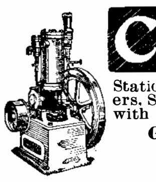

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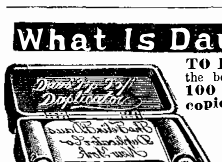

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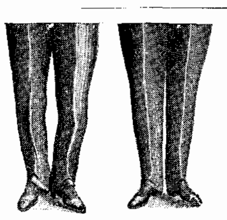

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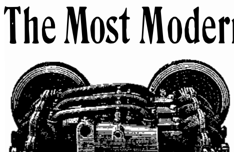

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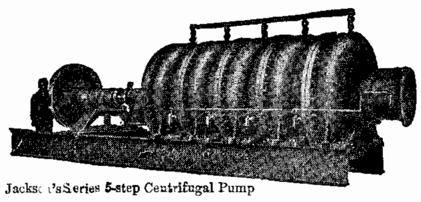

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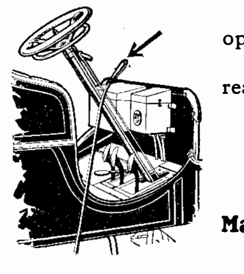

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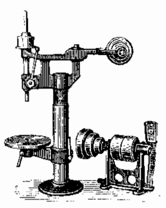

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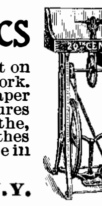

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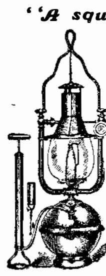

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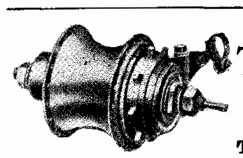

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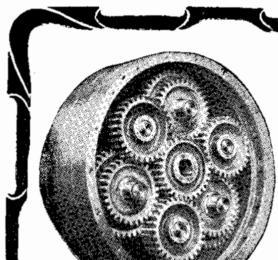

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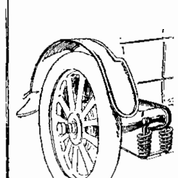

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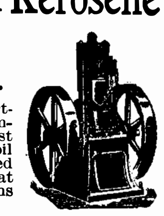

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